NOVEMBER, 1956

METAL FINISHING

DEVOTED EXCLUSIVELY TO METALLIC SURFACE TREATMENTS

FOUNDED 1903

Complete Contents Page 45

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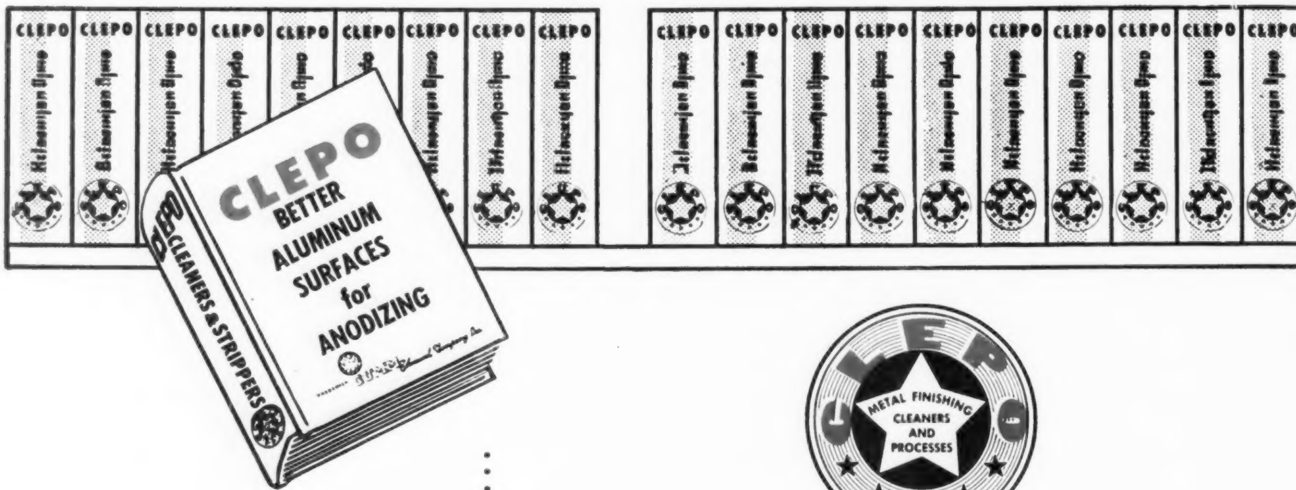

IN THE ALUMINUM FIELD

SOAK CLEANER	**CLEPO 86-P,** *mild for general use*
SPRAY CLEANER	**CLEPO 85-AN,** *for wash machines*
SPRAY CLEANER	**CLEPO 8-S,** *special for deep-drawn articles*
HAND WIPER	**CLEPO 35-W,** *solvent type cleaner*

1 SERVICE As many treatments as there are problems

WATER STAIN REMOVER	**CLEPO 192-A and 180-K,** *an effective series team*
PITTING EQUALIZER	**CLEPO SAT-N-ETCH,** *fast acting etchant*
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STRIPPER	**CLEPO 195-A,** *no harm to metal, no objectionable fumes*

• **The above is just to name a few**

CLEPO Field Men have a thorough understanding of anodizing operations and of surface preparation problems in connection with anodizing. By all means call on them for service. And, as is implied by the above partial list of CLEPO Products, they have many formulations from which to select to take care of your specific requirements.

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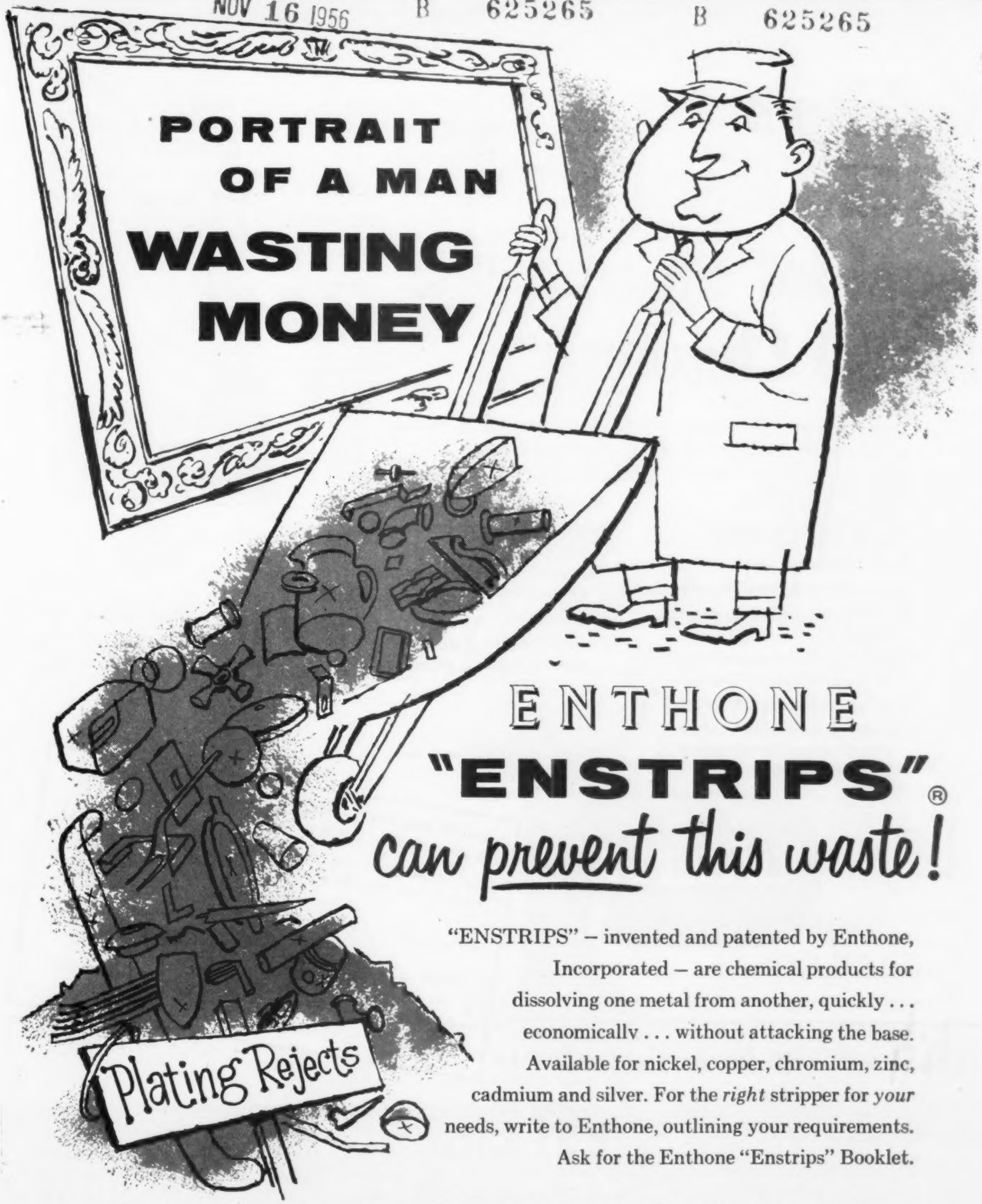

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Metal Finishing Processes • Electroplating Chemicals

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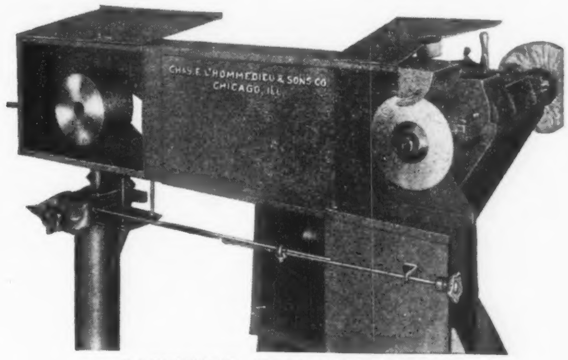
Metal Finishing is published monthly by the Finishing Publications, Inc., 381 Broadway, Westwood, New Jersey, U.S.A.
Entered as second class matter at the Post Office in Westwood, N. J. Volume 54, No. 11, November, 1956. Four Dollars Per Year.

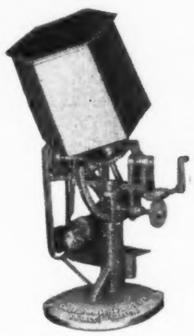
USE "RELIANCE" PRODUCTS FOR

ECONOMY : EFFICIENCY : DEPENDABILITY

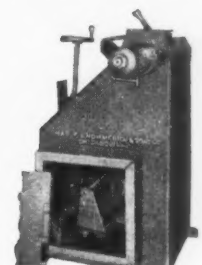
WRITE FOR FURTHER DETAILS



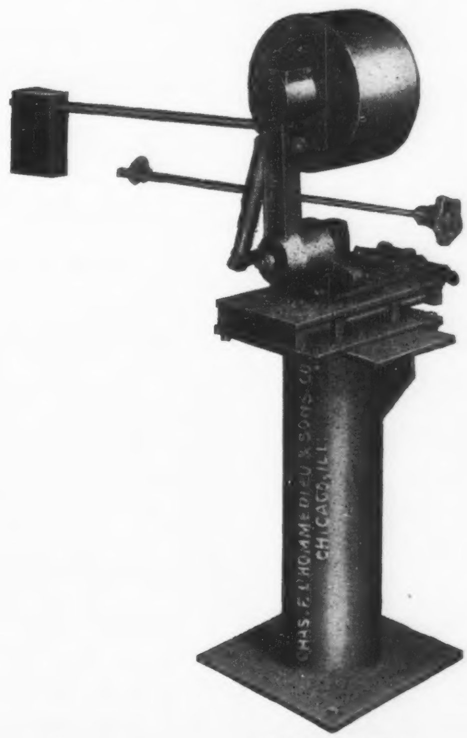
BACKSTAND IDLER WITH LATHE



OBLIQUE
TUMBLING BARREL



#23A
POLISHING LATHE



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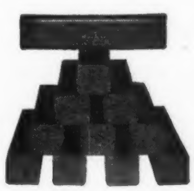

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Complete Plating Plants Installed

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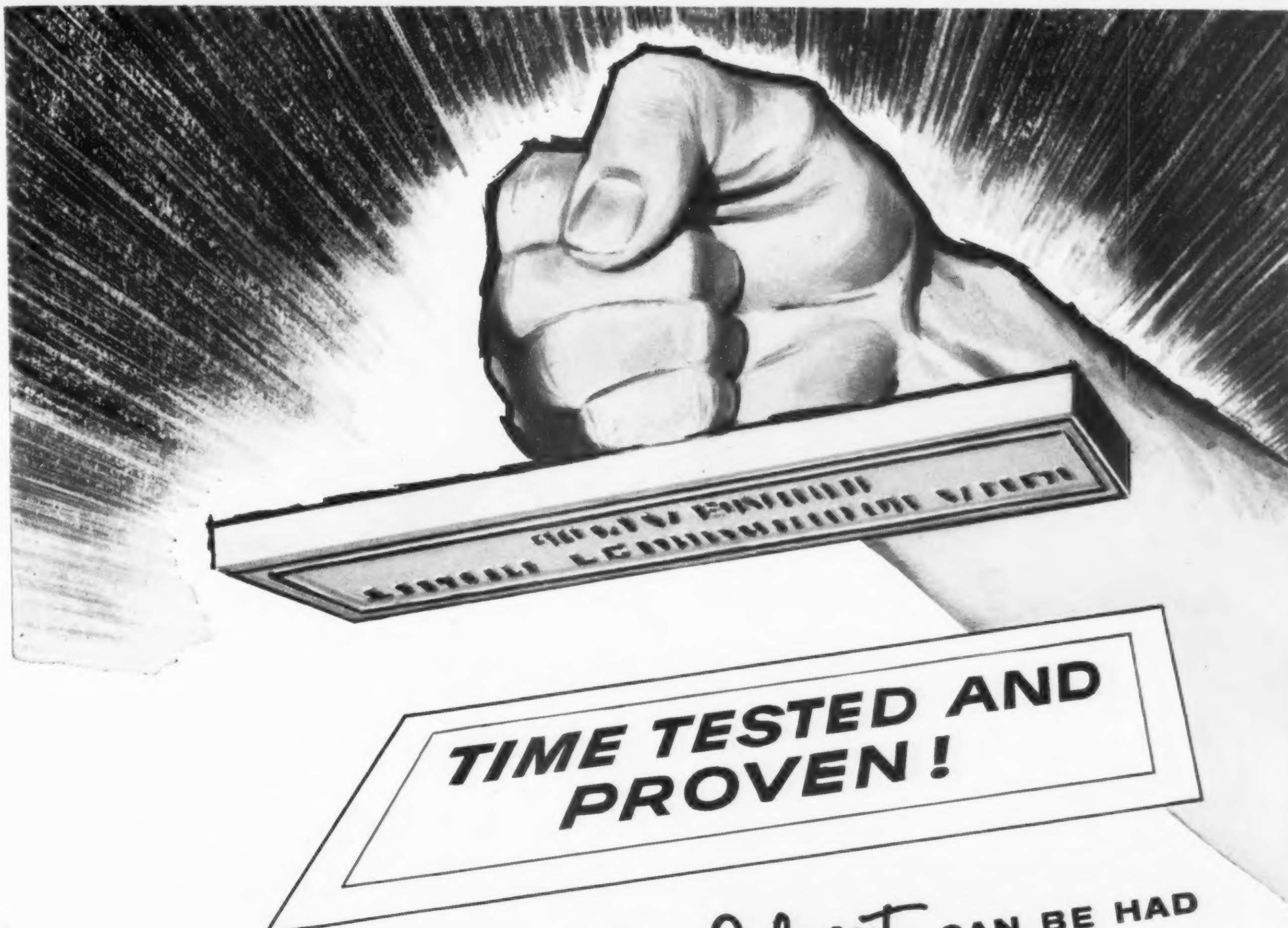

NO BETTER *Degreasing Solvent* CAN BE HAD

BLACOSOLV®

THE SOLVENT WITH THE ORIGINAL NEUTRAL STABILIZER

No other degreasing solvent made has greater resistance to heat, air, light. Blacosolv is most gentle, won't stain or etch the most highly polished metal surfaces...It stands up under the action of aluminum and has a greater capacity for absorbing acids, oils and coolants. Blacosolv maintains its stability after repeated distillation.
By comparison, Blacosolv is the most economical solvent you can buy.

Write for Complete information on Blacosolv Degreasing Solvent and Blakeslee Degreasers.

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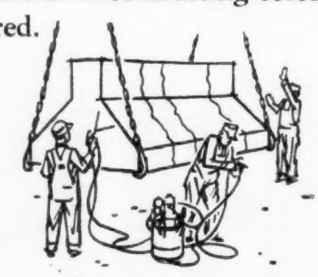
DON'T HESITATE!

MICCROSOL SPRAY S-2003 IS READY . . . to show YOU the way to profitable spray jobs

You can apply S-2003 with conventional spray equipment.

You can apply 60 mils thickness in one application without sagging of material. If multiple coats are required, a short cure time is all that's needed between applications. A contrasting color can serve for layer identification, if desired.



You can use S-2003 in all plating baths. It has the same toughness—chemical, corrosion, and abrasion resistance as Miccrosol E-1003. Our adhesive systems provide outstanding adhesion to metal surfaces.

Tanks
Ducts
and other
Equipment

Solvent additives are not necessary. S-2003 is 100% solids and is sprayed as received. Time consuming and expensive adjustments are unnecessary. Problems of material instability and film cracking are eliminated. There is no solvent loss and less operator fatigue with Miccrosol Spray S-2003.

It's the ideal plastisol for spray applications.

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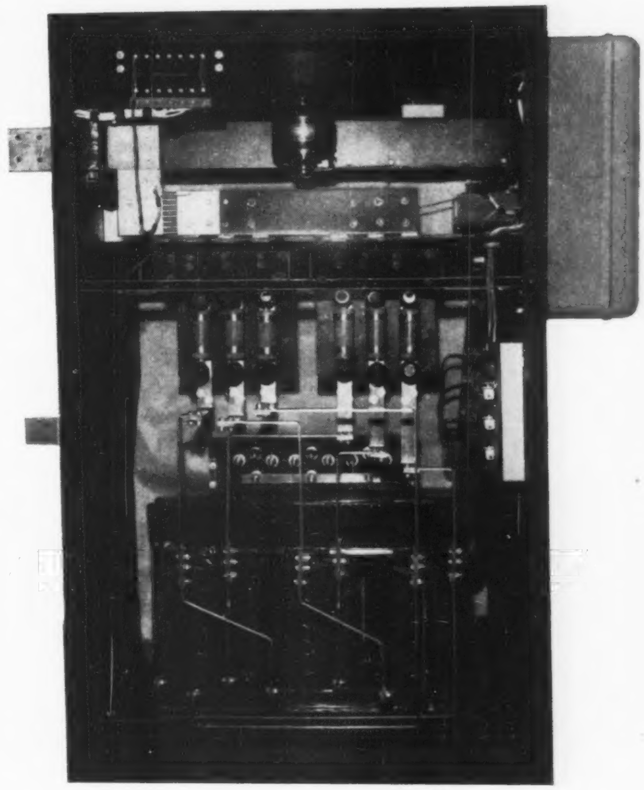
Germanium, last word in rectifiers.

RAPID GERMANIUM RECTIFIER

Model G1540

efficient . . . compact . . .
sealed junctions . . . long lived

Rating
INPUT: 220V/3 ph/60 cyc.
OUTPUT: 1500 amps/40 volts



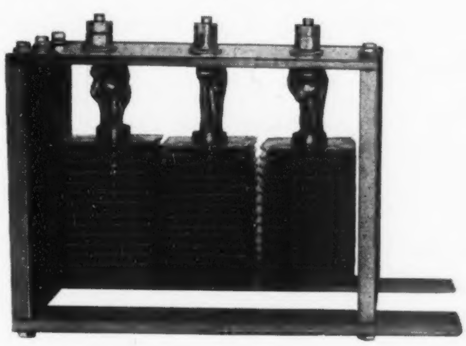
Operating efficiency is over 90% at full load. Accompanying this high level of efficiency is a greater degree of voltage stabilization, with a minimum voltage variation of less than ± 1 volt from no load to full load, without additional components.

Long life expectancy is acclaimed, as accelerated aging tests at high temperature operation indicates.

Germanium junctions are hermetically sealed reducing corrosive action and other atmospheric conditions.

Forced air cooling, accomplished by heavy-duty, ball-bearing, self-lubricating motors together with conservative design increase the safety factor. All units are fully protected by ample circuit fusing.

Rapid Germanium is truly the BEST rectifier buy, high in value (costing the same as selenium units in many models), and low in operating cost.

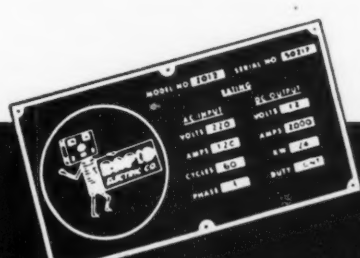


Voltage selection is obtained by tap switch control or Rapid inductor control.

Rapid rectifier's exclusive voltage control is motor operated, oil immersed, continuously variable; for full voltage range.

Requiring a mere press of a button to select any point within the output range of the unit, the Rapid inductor control accomplishes it smoothly and continuously.

See your plating distributor soon: He will be pleased to help you select the model you require for your plating needs.



THE NAMEPLATE THAT MEANS "More Power to You!"

RAPID ELECTRIC COMPANY

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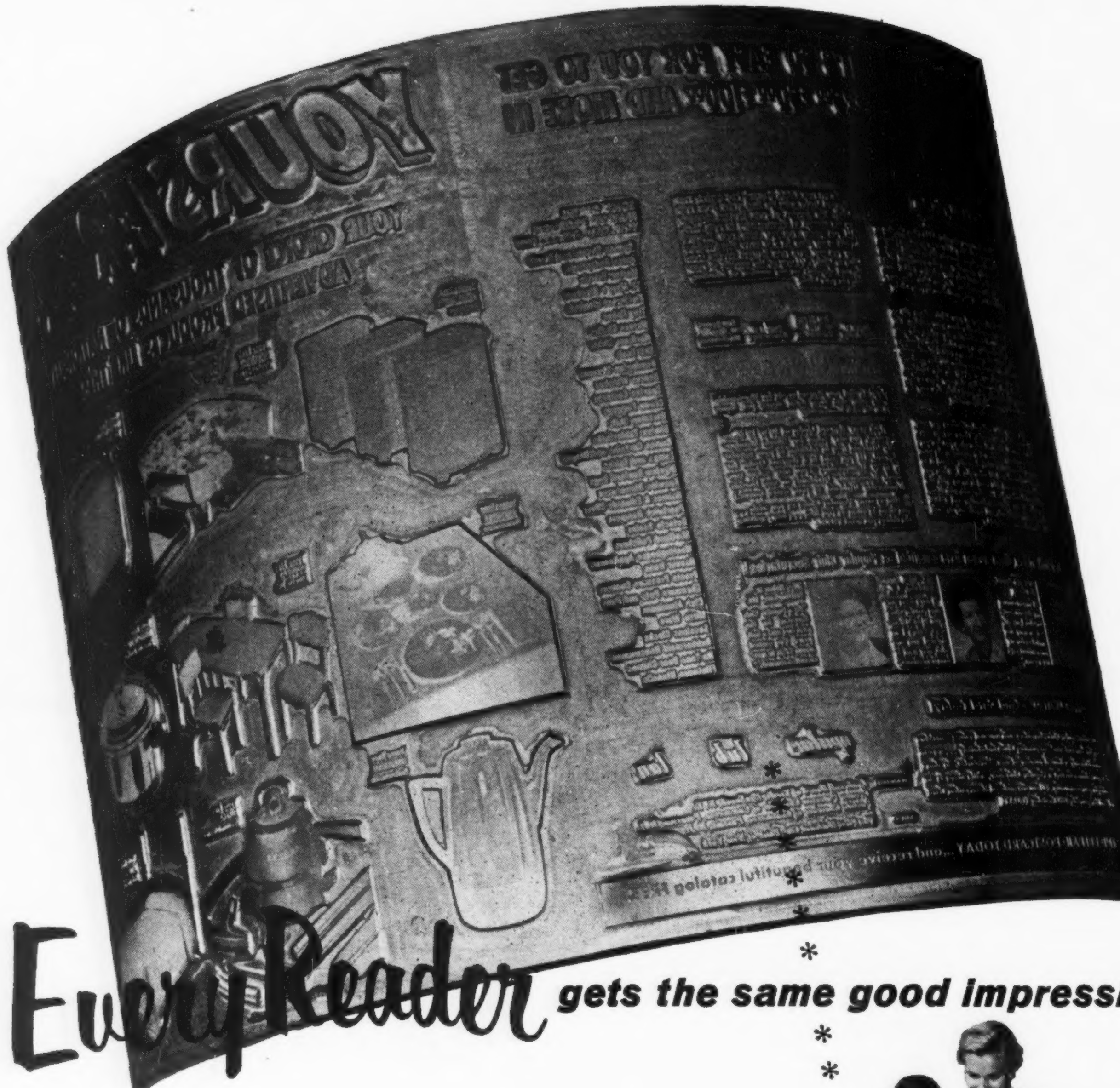
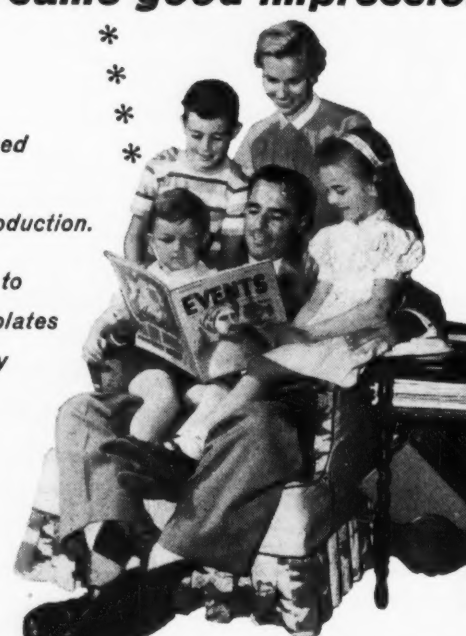


Every Reader gets the same good impression



• *Magazines with circulations running in the millions are faced with a serious problem. When the type or half-tone dots wear down to the shoulder of the etch, the result is a poor reproduction.*

To save press down-time in replacing worn plates, and to be sure of the same fine impression on the last part of the run, plates must have surfaces that are resistant to abrasion. That's why printers use chromium-plated letterpress plates, electrotypes and gravure rolls. Then they are certain of getting clear impressions on every sheet from the first to the last.

As a manufacturer of Chromium Chemicals, Mutual is proud to emphasize their use in the American publishing field.

MUTUAL

MUTUAL CHEMICAL DIVISION

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SODIUM BICHROMATE
CHROMIC ACID
POTASSIUM BICHROMATE
AMMONIUM BICHROMATE

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Most versatile of all fully automatic plating and anodizing machines

New! LASALCO'S *Cycleflex*

- Cycle changing requires no costly overhaul or rebuilding. Only the positions of pick-up heads need be moved, plus minor tank partition changes.
- New, simple electro-mechanical control and safety device eliminates all possibility of conveyor failure . . makes it impossible to push racks into side of tank prevents load from dropping if power fails during work transfer.
- Unusually low headroom required because no elevating mechanism operates above rack carrier.
- Self-cleaning heavy duty contacts have positive 3-point connection . . . need practically no attention.
- Easily removable rack carriers leave tank surfaces clear . . . an advantage in servicing and in manual plating of large pieces.
- Automatic loading and unloading of parts from standard double-spine racks is available . . . parts can be automatically unloaded while racks stay on machine.

Hydraulic operation, standard; pneumatic operation, optional.

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SPECIAL REPORTS ON FINISHING NON-FERROUS METALS

NUMBER I—Decorative, Corrosion-Resistant Finishing with Iridite

Chromate conversion coatings are well known and accepted throughout industry as an economical means of providing corrosion protection, a decorative finish or a good paint base for non-ferrous metals. However, continued developments are so rapid and widespread that many manufacturers may not be completely aware of the breadth of application of this type of finish. Hence, this digest of current information; to bring you up to date on the many ways in which you can combine salable appearance with durability in one finish at a competitive price advantage. Report II on paint base, corrosion-resistant finishes and Report III on chemically polished, corrosion-resistant finishes are available on request.

First, as a basis for this discussion, a "decorative" finish is considered as any chromate film that is used as a final finish in itself. It may be truly decorative in that its sole purpose is to enhance the beauty of the product. For example, a bright chrome-like finish or a pleasing bronze appearance are among the many effects that can be obtained. It may be functionally decorative in that it reduces reflectivity for camouflage purposes or provides a means of color-coding parts. But, in all cases, the Iridite films protect the metal against corrosive attack.

Iridite finishes are now available for all commercial forms of the more commonly used non-ferrous metals, including zinc, cadmium, aluminum, magnesium, silver, copper, brass and bronze. These films can produce a wide variety of pleasing appearances. The basic colors of the Iridite coatings are grouped below by metals.

ZINC and CADMIUM: Metallic bright, light iridescent, iridescent yellow, bronze, olive drab.

COPPER, BRASS, BRONZE: Metallic bright, yellow.

ALUMINUM ALLOYS: Clear, iridescent yellow, brown.

MAGNESIUM ALLOYS: Metallic bright, iridescent yellow-red, brown.

SILVER: Metallic bright.

In addition, many films can be modified by bleaching or by dyeing. Among the dye colors available are various shades of red, yellow, green, blue or black.

Depending upon the metal and the Iridite used, corrosion resistance of clear and bright films ranges from mild passivity to as high as 500 hours in salt-spray; on heavier dark films, salt-spray resistance ranges from approximately 100 to 1000 hours.

It is this combination of decorative and corrosion resistant properties that accounts for the widening use of Iridite finishes. For example, Iridites #4-73 and #4-75 (Cast-Zinc-Brite) make possible for the first time, a combination of lustrous chemical polishing of the as-cast surface of zinc die castings and good resistance to corrosion. Further, in many cases, sizeable savings in the cost of buffing and electroplating are realized.

WHAT IS IRIDITE®?

Briefly, Iridite is the tradename for a specialized line of chromate conversion finishes. They are generally applied by dip, some by brush or spray, at or near room temperature, with automatic equipment or manual finishing facilities. During application, a chemical reaction occurs that produces a thin (.00002" max.) gel-like, complex chromate film of a non-porous nature on the surface of the metal. This film is an integral part of the metal itself, thus cannot flake, chip or peel. No special equipment, exhaust systems or specially trained personnel are required.

On many steel parts, a simple system of zinc or cadmium plate and bright Iridite is used instead of more costly electroplated finishes to provide a bright, decorative and protective finish with tremendous savings in material, equipment and labor.

In finishing aluminum, where corrosion resistance or paint adherence is the prime consideration, the aircraft industry has all but abandoned the anodizing process in favor of recently developed chromate conversion coatings, among them Iridite #14 and #14-2 (Al-Coat). These formulations and their method of application can be varied to retain the original metallic appearance while providing acceptable corrosion resistance, or to produce a fully colored brown finish that offers exceptional corrosion protection. Again, time and man-power savings are astounding—one company saved at least $15,000 a year on maintenance of racks alone and another $40,000 on materials and labor in only nine months. In addition, of course, hundreds of thousands of dollars are saved by eliminating the need for expenditures for generators, heating equipment and racks.

Iridites are widely approved under both Armed Services and industrial specifications because of performance, low cost and savings of materials and equipment.

In planning or designing, you should consider the many other characteristics of Iridite finishes which may enter into the specific problem. In addition to having decorative and protective functions, these chromate coatings form an excellent base for organic finishes and bonding compounds. They have low electrical resistance. Some can be soldered and welded. The Iridite film itself does not affect the dimensional stability of close tolerance parts.

You can see then, that with the many factors to be considered, selection of the Iridite best suited to your product requires the services of a specialist. That's why Allied maintains a staff of competent Field Engineers—to help you select the Iridite to make your installation most efficient in improving the quality of your product. You'll find your Allied Field Engineer listed under "Plating Supplies" in your classified telephone book. Or, write direct and tell us your problem. Complete literature and data, as well as sample part processing, is available. Allied Research Products, Inc., 4004-06 E. Monument Street, Baltimore 5, Maryland.

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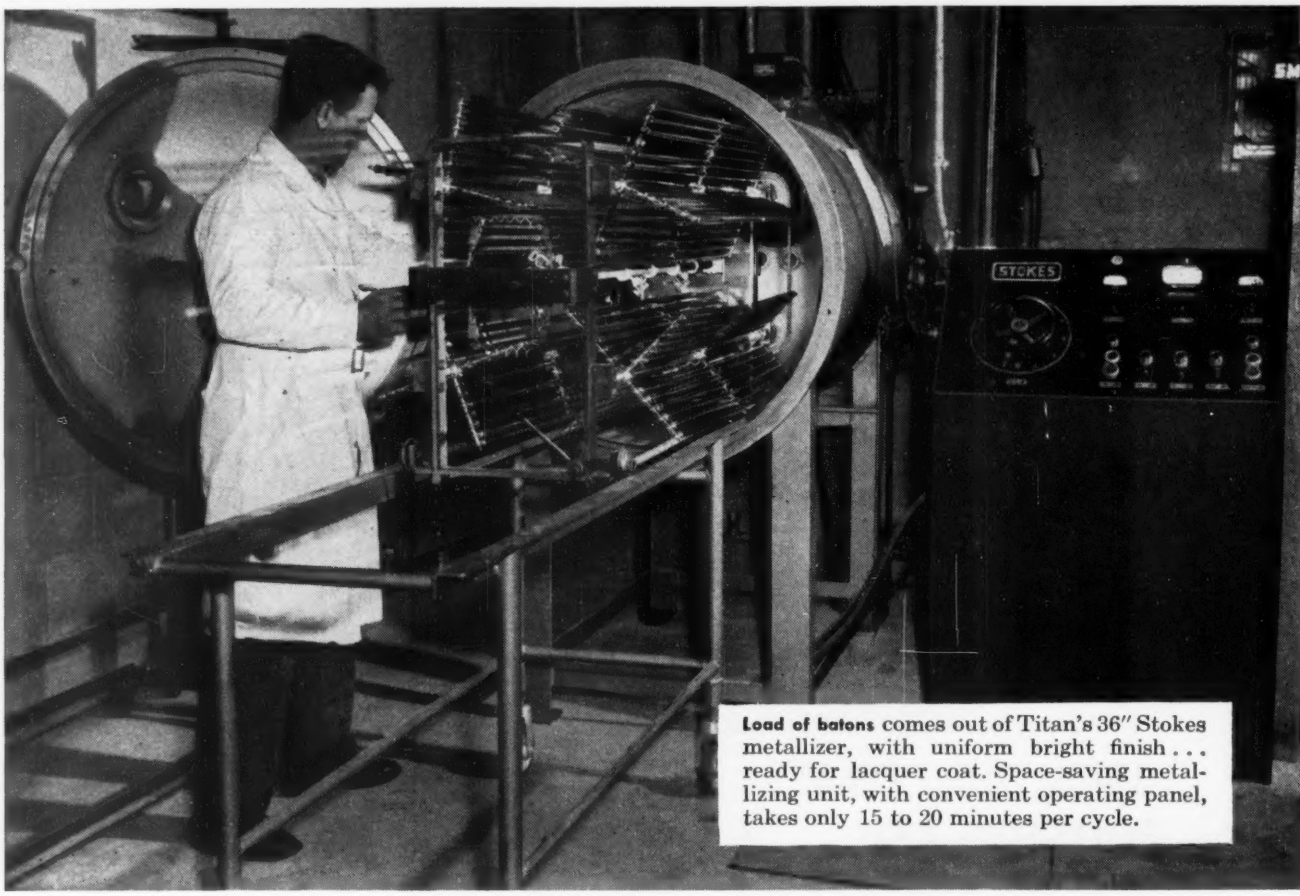

Load of batons comes out of Titan's 36" Stokes metallizer, with uniform bright finish . . . ready for lacquer coat. Space-saving metallizing unit, with convenient operating panel, takes only 15 to 20 minutes per cycle.

How "vacuum plating"...using Stokes metallizers...can cut metal finishing costs

At Titan Valve & Mfg. Co., metal parts plated in a Stokes metallizer get a finish as attractive as polished chromium . . . in brilliant colors if desired . . . at costs substantially lower than for electroplating.

Vacuum metallizing, widely used for bright finishing of plastics and other non-metals, also proves highly useful and economical on many metal parts. The experience of Titan Valve & Mfg. Co. of Cleveland, is typical of the results that can be obtained by this process. This company does a large volume of custom finishing of varied metal goods, including tubes for batons, zinc-base die-cast valve knobs and indicator dials . . . which they "vacuum plate" with aluminum in their Stokes Model 428 metallizer.

Durable finish. On the basis of performance tests, the metallized finishes are equal in durability to the best baked lacquer or enamel.

Low production cost. The vacuum metallizing process costs less per piece than either plated or anodized finishes where buffing or polishing is required.

Low equipment investment. Total cost of the metallizing equipment and auxiliaries is only about half that of comparable electroplating equipment. The same equipment, moreover, can be used to bright finish a great variety of pieces simultaneously.

Specialists in high vacuum equipment for more than 30 years, Stokes makes a varied line of metallizing units, in sizes to fit your production requirements. Write to Stokes for literature, and for a personal discussion by a Stokes engineer on your specific application.

High Vacuum Equipment Division

F. J. STOKES CORPORATION

5518 Tabor Road, Philadelphia 20, Pa.

STOKES

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All these and many more products can be finished less expensively with this plate
New Bronze Plating Discovery
eliminates buffing
...excellent corrosion resistance
minimizes need for nickel
Here's a revolutionary advance in electroplating—"Bright LUSTRALITE 10," a new process that gives you several important advantages.
The plate has remarkable leveling power, with a true bright finish that needs no buffing or polishing. Its outstanding corrosion resistance makes it an excellent substitute for nickel. It eliminates the need for a copper plating and can replace all or most of nickel plating normally required.
"Bright LUSTRALITE 10" produces a brilliant bronze that's fine-grained and hard . . . practical for both decorative and corrosion-protective purposes. Learn for yourself how it can help you speed plating operations, cut production costs and improve your products. It's available through the same distributors that handle other Battelle processes listed on the opposite side of this page.

A Timely Message on

"Personality" in Metals

by Ben P. Sax

President, American Buff Company

Among metals as well as people, the inherent characteristics of the individual determine its "personality" . . . its resistances and adaptabilities . . . its weaknesses and strengths. In the past, the differing personalities of various metals have demanded special methods and costly operations . . . costly in both time and finishing materials.

Now, the wide range of special buff types makes many of these expenses unnecessary. Specially engineered, cool-running buffs which permit high running speeds without burning, produce truly amazing savings in finishing time and consequent man-hour costs. New developments in buff materials often change the entire production picture.

On aluminum castings, for instance, these modern buffs effect savings up to 31%. Extra-flexible units of cloth-wrapped sisal give fast, hard cutting on irregular and contoured surfaces. Their special ability to reach into narrow crevices, follow every contour and high spot on parts for appliances, furniture, etc., produces top-notch cutting and coloring in a single operation. New ruffled-face "open" bias sisal buffs, with cloth layers, eliminate streaking problems on aluminum, brass, steel, etc., and combine fast cutting with high-lustre finishing.

These and other modern developments such as pre-assembly of centerless buffs, produce gains in output ranging from 25% to 33% on existing equipment, play an important part in bringing the cost of consumer goods within popular price levels. All this adds up to substantially improved profit volume for the metal finisher.

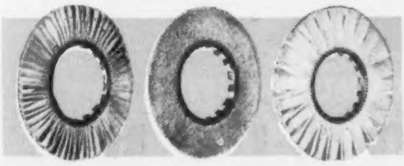
We take special pride in our ever-growing contributions to profitable operation in the entire metal finishing industry. It will be a pleasure to serve *your* needs.

Sincerely,

Ben P. Sax

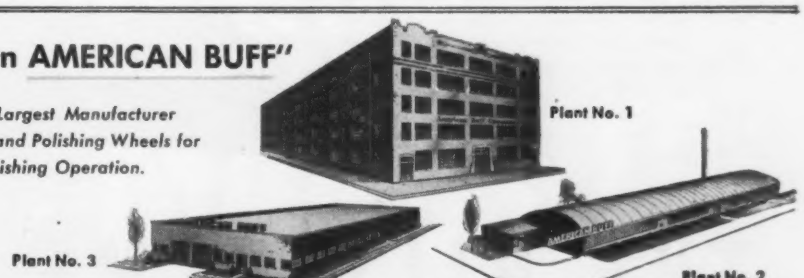
"For the job that's TOUGH—use an AMERICAN BUFF"

World's Largest Manufacturer of Buffs and Polishing Wheels for Every Finishing Operation.



BIAS CLOTH • BIAS SISAL • UNIT CLOTH OR SISAL

Patented CENTERLESS Construction
Pat. No. 2,582,506



American Buff Company
2414 S. La Salle Street Chicago 16, Illinois

AMERICAN BUFFS ARE REGULARLY ADVERTISED IN FORTUNE MAGAZINE

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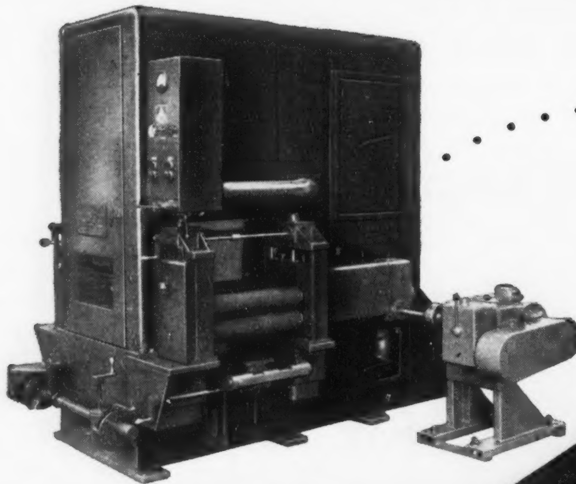
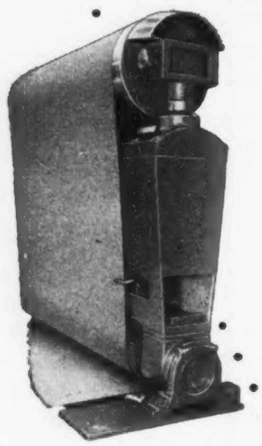
for FINISHES that pass inspection the FIRST TIME get a HILL Grinding & Polishing Machine



ABRASIVE BELT GRINDING & POLISHING MACHINE
(Pinch Roll Type)

For pre-finishing, conditioning and polishing sheets, plates, strips or blanked-out shapes in flat form. Used as single units or in multiple units for progressive line polishing.



The basic HILL two-roll vertical head with endless abrasive belt. Used in both the Pinch-Roll and the Hydraulic Table types.

● HILL 2-ROLL Vertical Abrasive Belt Grinding and Polishing Machines are made in two general types for producing superior finishes on flat surfaces as required by manufacturers of a wide variety of products such as decorative plastics, auto bumpers, engravers plates, home appliances, etc.

Both types are built in polishing widths up to 60" and larger sizes can be furnished if desired. Your problem will be given our prompt and careful attention.

ABRASIVE BELT POLISHING MACHINE
(Hydraulic Table Type)

For flat polishing of sheets and plates of ferrous and non-ferrous metals. Made in a variety of table widths and lengths with full hydraulic reciprocating table.

THE HILL ACME COMPANY

1209 WEST 65th STREET • • • CLEVELAND 2, OHIO

"HILL" GRINDING & POLISHING MACHINES • HYDRAULIC SURFACE GRINDERS • ALSO MANUFACTURERS OF "ACME" FORGING • THREADING TAPPING MACHINES • "CANTON" ALLIGATOR SHEARS • BILLET SHEARS • PORTABLE FLOOR CRANES • "CLEVELAND" KNIVES • SHEAR BLADES

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Not a Trace

. . . of RESIDUE, that is

with NEW AHCO Burnishing Compounds

Residue vanishes in a water rinse . . . burnished surfaces are left clean, bright, and film-free, but it's no mystery because this new series of AHCO Burnishing Compounds is formulated only from non-saponaceous materials that contain the last word in surface-active agents. These compounds are free-flowing, dry, non-toxic, and non-corrosive powders which are, of course, freely soluble in water. They're prepared especially for applications where the sticky residues from soap-like mixtures are objectionable. For rolling and burnishing before plating, AHCO burnishing Compounds assure excellent adhesion and maximum lustre. For preparing surfaces before lacquering, painting or other processing . . . for burnishing plated parts to remove plating compound residues, that would cause staining or spotting, there are AHCO Burnishing Compounds made to order. Find out *now* how one or more of the many new AHCO Burnishing Compounds can do that better job in your plating or finishing room.

For full details about AHCO Burnishing Compounds write today for Bulletin B-10 to Apothecaries Hall Co., 22 Benedict Street, Waterbury, Connecticut.

Apothecaries Hall Co.

APOTHECARIES HALL COMPANY WATERBURY CONNECTICUT 1849

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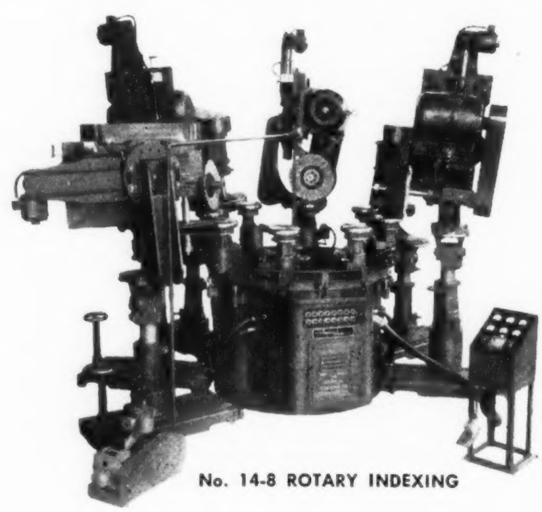
"REMINDS ME OF MY *PACKER-MATIC* UNIFORMITY"



No. 14-8 ROTARY INDEXING

PACKER-MATICS ability to polish and buff your product with the highest degree of uniformity . . . automatically at high speed . . . affords plenty of profit opportunities for you.

As the products move from station to station, precisely angled and evenly dressed wheels produce consistently better finishes in a fraction of hand operation time . . . automatically.

There are a variety of Packer-Matics with the speed and versatility to meet your most exacting requirements for faster, more uniform, low cost polishing, buffing and deburring.

OUR ENGINEERING STAFF INVITES YOUR INQUIRY.

PACKER-MATIC

AUTOMATIC MACHINES FOR BUFFING • POLISHING • DEBURRING

THE PACKER MACHINE COMPANY • MERIDEN, CONNECTICUT

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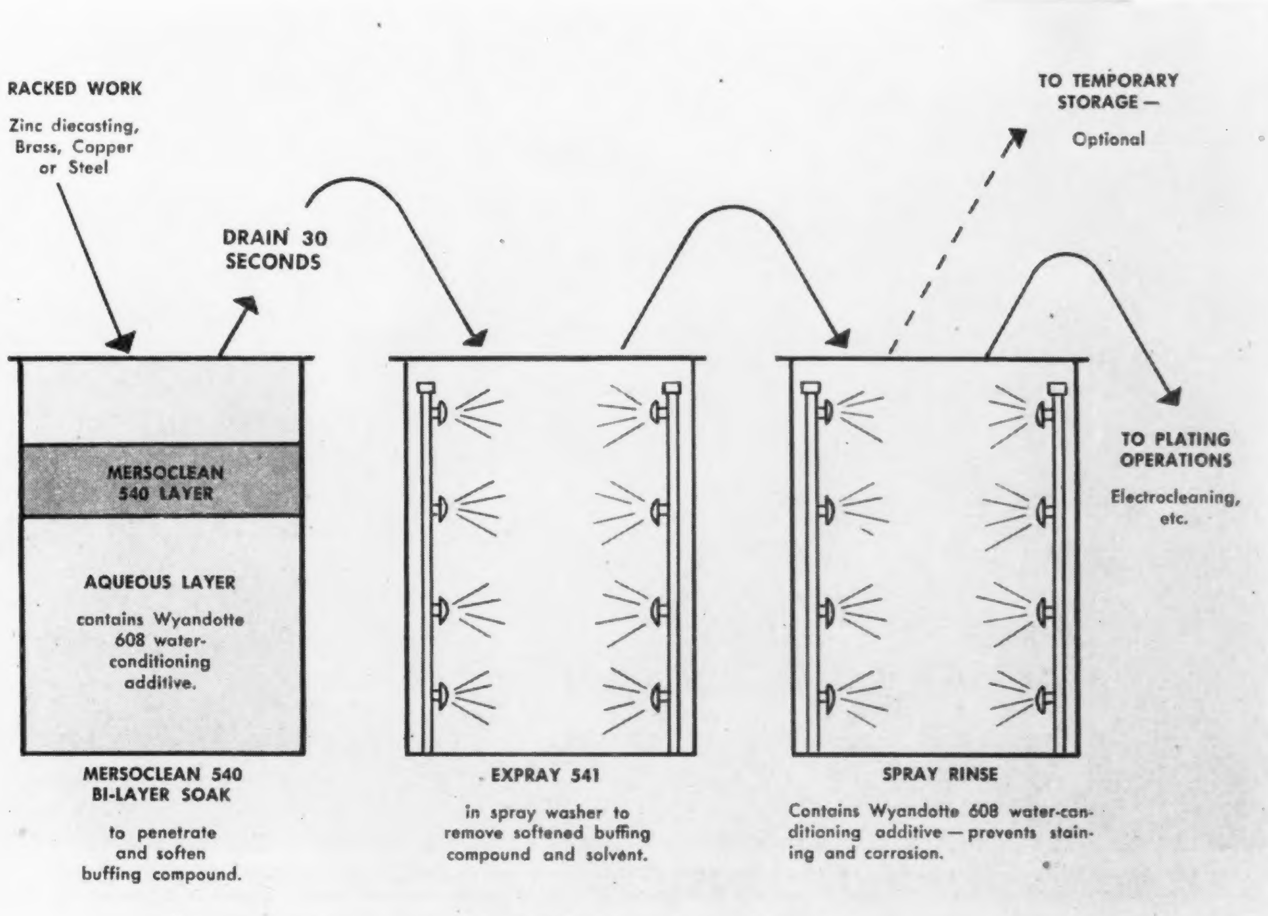
New MERSOCLEAN 540 Bi-Layer Process

WHISKS AWAY STUBBORN BUFFING COMPOUND

from zinc diecastings, brass, copper, and steel!



Here's a new precleaning process for buffed metals proved effective on *millions of diecastings!* It's Wyandotte's MERSOCLEAN 540 Bi-Layer Process. It completely removes buffing compounds, even in deep crevices; and it results in fewer rejects, less labor, increased production.

Greater Safety

This process practically banishes fire hazards, hand swabbing, obnoxious odors; is safe, nontoxic. It reduces cleaning costs, while giving improved cleaning.

More thorough cleaning

Wyandotte MERSOCLEAN 540 Bi-Layer Process costs less than solvent degreasing — yet is more effective. It does a more thorough job than wetting agents and soap mixtures. Even when castings or parts are heavily soiled with impacted or baked-on buffing compounds, this revolutionary process whisks them clean, insures bright plating *all over!*

Easy to use

Control of solutions is easily accomplished by non-technical personnel with simple, free kits provided for users.

Why not look into Wyandotte's MERSOCLEAN 540 Bi-Layer Process for your own operations? Even though the process may require some modifications of existing equipment, we believe it to be worthy of serious consideration wherever buffing- or polishing-compound removal is a problem, because it provides a *foolproof* way of removing all commonly used compounds. We have skilled representatives, trained to help you. Contact the one nearest you, today! *Wyandotte Chemicals Corporation, Wyandotte, Michigan. Also Los Nietos, California. Offices in principal cities.*

Wyandotte CHEMICALS

J. B. FORD DIVISION

THE BEST IN CHEMICAL PRODUCTS FOR METAL FINISHING

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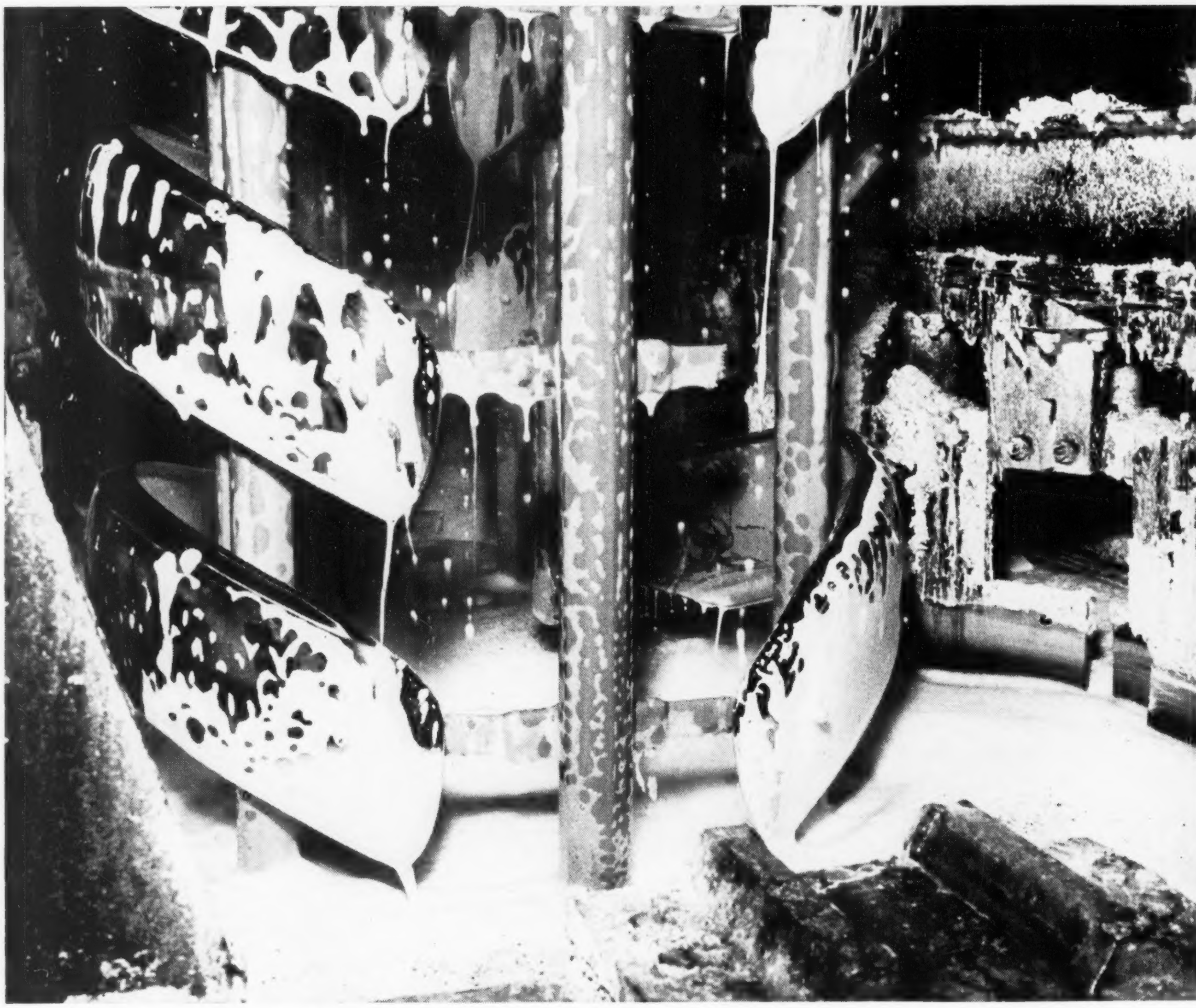

Auto bumper wings get fast, thorough stripping in Dow Sodium Orthosilicate to remove buffing compound prior to final chrome-plating. Same effective cleaning compound is used at earlier step in operation, stripping bonder lubrication before bumper is copper-plated.

DOW SODIUM ORTHOSILICATE

strips buffing compounds, other tough contaminants with real speed

Do parts reach your cleaning operation carrying heavy residues of buffing or drawing compounds? Strip them good and clean . . . and do it *faster* . . . with high-powered Dow Sodium Orthosilicate metal cleaner.

Dow Sodium Orthosilicate is built and balanced to deliver low-cost, reject-free runs on almost any type of metal part. High acid capacity, high pH . . . Dow Sodium Orthosilicate removes oils, fats and waxes with uniform economy whether your cleaning is dip, soak or electrolytic. The extremely high electrical conductivity of Dow Sodium Orthosilicate solutions permits high current density *without* excessive voltage.

For ready emulsification, no redeposition, fewer rejects, and lower costs per run, get Dow Sodium Orthosilicate. For detailed information on advantages and use, get a free copy of the new Dow Sodium Orthosilicate booklet. Call the Dow sales office near you or write direct to THE DOW CHEMICAL COMPANY, Dept. AL 766J, Midland, Michigan.

you can depend on DOW CHEMICALS DOW

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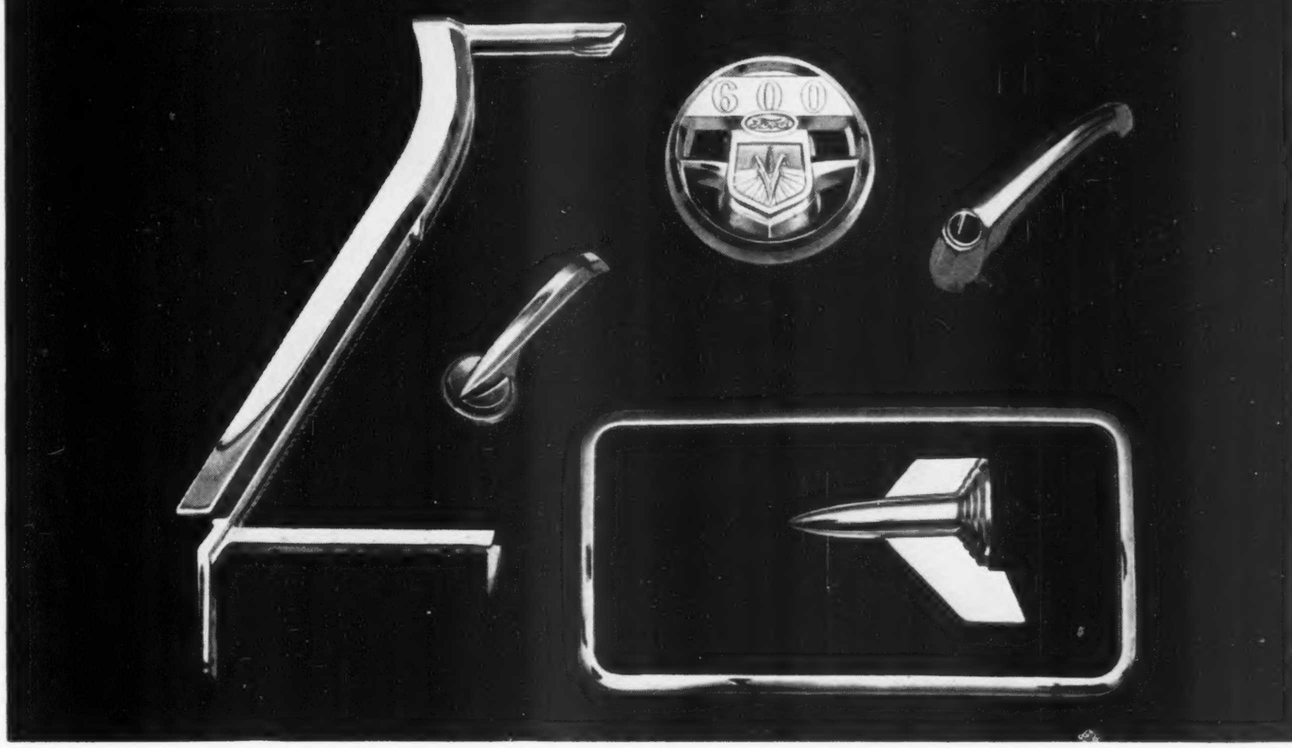
a new superior copper process



ISO-BRITE COPPER

You needed it! Wagner developed it! You'll praise it!

NEW . . . BETTER . . . BEST . . ! "Words, words, just another claim," you may think, for rare indeed is anything new really superior in your metal finishing world. But we at Wagner Brothers have spent years on the copper problem and the *production* performance of *our* new ISO-BRITE Process has encouraged us to go all out. So we're making *big claims.* But these claims have already been *proven* by the most critical of production platers—and we're anxious to prove them to you. We offer you . . .

1. Ease of control—and our proof is the voluntary praise of dozens of qualified men in automotive, hardware, plumbing and other fields.
2. High anode efficiency—virtually eliminating costly copper cyanide additions. Just replace drag-out.
3. Much heavier plate—one case previously averaging .0004″ increased by ISO-BRITE COPPER to .0008″ at the same check points, by eliminating sacrificial wave forms.
4. Freedom from roughness—electrolyte has no inherent tendency or characteristic to promote rough deposit. Our technical staff can advise you on contributing physical or mechanical causes.
5. Fine grained, dense, ductile deposit—fully bright coming out of the bath, easily buffed if your job is steel.
6. Wide operating range—up to 60 amperes per sq. ft. in actual production. Temperature range from 135° to 165°.
7. High tolerance of organic contamination—much less maintenance. Excellent for die castings.

Of course, Wagner ISO-BRITE Copper costs no more than competitive copper solutions—yet it saves money in every way while producing vastly higher quality. We can't hope to have you accept all we claim here; we offer the proof of the pudding. Wire, phone or write for Bulletin 70.2 and the name of the Wagner man in your area.

400 MIDLAND AVE., DETROIT 3, MICHIGAN

CHICAGO • CINCINNATI • CLEVELAND • INDIANAPOLIS • NEW YORK • ROCHESTER • GRAND RAPIDS

Wagner BROTHERS INC.

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new,

fast,

ALKALINE

De Ruster #2

Does not attack ferrous metals

Non toxic

Economical

No hydrogen embrittlement

No dimensional changes

Also removes paints, oils

Alkaline De Ruster No. 2 is the new Mitchell-Bradford non-electrolytic compound for removing rust quickly from ferrous metals. Since it concentrates its action on the rust itself, it produces no dimensional changes yet leaves the surface not only clean but without the tendency to re-rust.

Alkaline De Ruster No. 2 contains no dangerous acids, produces no harmful fumes. This eliminates the risk of hydrogen embrittlement and produces a surface ideal for subsequent finishing processes such as plating, phosphating, black oxidizing, etc. Alkaline De Ruster No. 2 is used in various concentrations in water of 180° to boiling. It is economical, safe to use, completely dependable. Write us about your rust removal problem!

Mitchell-Bradford

MITCHELL-BRADFORD CHEMICAL CO.

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QUALITY PRODUCTS OF CHEMICAL RESEARCH

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Another Richardson-Allen Engineering "First"

Demonstrating the same unsurpassed initiative, ingenuity and craftsmanship which, over the years, have set the pace of progress for the entire industry. Richardson-Allen engineers—working in close cooperation with Westinghouse engineers—have developed and perfected the ultimate in power rectification.

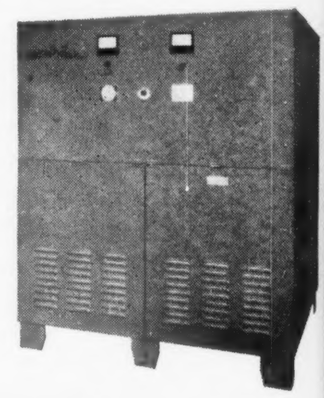
SILICON

DEPENDABLE POWER RECTIFIERS

HERMETICALLY SEALED JUNCTIONS — HIGH TEMPERATURE OPERATIONS

VERSATILITY—Richardson-Allen silicon rectifiers are now available for the plating and industrial fields in ratings up to 500 kws.

EFFICIENCY—Richardson-Allen silicon rectifier units are now supplying major industries with an unprecedented amount of direct current—with no loss in efficiency, no aging and no apparent limit to the life of the silicon junctions. Single silicon junctions are designed to withstand up to 300 vpi.



ECONOMY — Occupying unbelievable small space, the initial cost is often lower than other conversion methods; practically no maintenance is ever needed and when installation savings and power savings are figured the total amount is impressive.

For additional information, write to:

RICHARDSON-ALLEN Corporation

DEPENDABLE RECTIFIER SPECIALISTS

a Manufacturing affiliate of

WESLEY BLOCK & CO., INC., 116-15 Fifteenth Ave., College Point, L. I., N. Y.

IN CANADA: Richardson-Allen of Canada, Ltd., 1236 Birchmount Rd., Scarborough, Ontario

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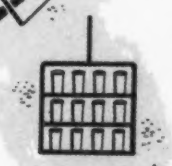
Aluminum
anodizing, buffing and cleaning

No matter what your aluminum finishing problem or need, you'll find the answer at H-VW-M . . . because it is the one company combining a complete engineering service with a complete line of equipment and supplies!

ELECTRICAL EQUIPMENT — Want the best possible recommendation of a Rectifier . . . Generator . . . or Control Equipment for your particular operations? Page 2 tells how to get it.



STILL TANK OR FULL AUTOMATIC EQUIPMENT — Whatever your need — from a single component to a complete, integrated system— H-VW-M supplies it . . . Page 3.

ENGINEERING SERVICE AND INSTALLATION —H-VW-M engineers and technicians are anodizing equipment specialists, with years of experience. Page 3 tells why these H-VW-M services mean greater efficiency and savings in your plant.

ALUMINUM FINISHING SUPPLIES — Page 4 shows how H-VW-M research has resulted in new compounds, improved buffs and cleaners to make aluminum finishing easier, better.

HANSON-VAN WINKLE-MUNNING CO. MATAWAN, NEW JERSEY, U.S.A.

HANSON-VAN WINKLE-MUNNING COMPANY

MATAWAN, NEW JERSEY

Manufacturers of a complete line of electroplating and polishing processes, equipment and supplies

***Plants:* Matawan, New Jersey • Grand Rapids, Michigan**

***Sales Offices:* Anderson (Ind.) • Baltimore • Beloit (Wisc.) • Boston • Bridgeport • Chicago Cleveland • Dayton • Detroit • Grand Rapids • Los Angeles • Louisville • Matawan Milwaukee • New York • Philadelphia • Pittsburgh • Plainfield (N. J.) • Rochester • St. Louis San Francisco • Springfield (Mass.) • Utica • Wallingford (Conn.)**

These H-VW-M Anodizing and Finishing to New Savings, New Efficiency, New

ELECTRICAL EQUIPMENT

H-VW-M is the only manufacturer of both Germanium and Selenium Rectifiers *and* low voltage, direct current Motor Generator Sets for the metal finishing industry. This thorough experience in every phase of low voltage power generation and rectification means that when you bring your power problems to H-VW-M you're sure to get the perfect equipment recommendation.

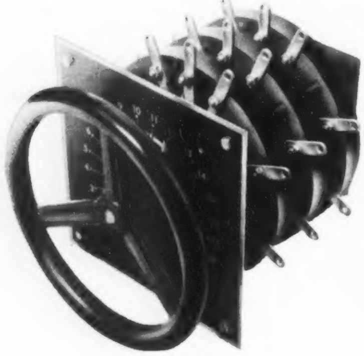
Self-Contained Rectifier with Tap Switch Control

Remote Controlled Rectifier with Tap Switch Control

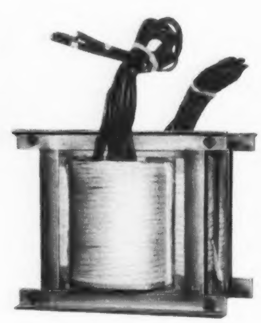
Germanium and Selenium Rectifiers . . . Rectifier Controls

Highest quality and efficiency, flexibility, economy and low maintenance are the characteristics combined in H-VW-M's full line of both Germanium and Selenium Rectifiers. 6 to 48 volt units—both remote and self-contained—provide the exact direct current low-voltage and high amperage required in aluminum anodizing. The widest possible choice of controls and control combinations is available. Such devices as manual or motor operated tap switch controls, continuously variable auto-transformers and saturable core reactors are used with or without supplemental controls to provide automatic voltage stabilization, automatic constant current as well as automatic programming.

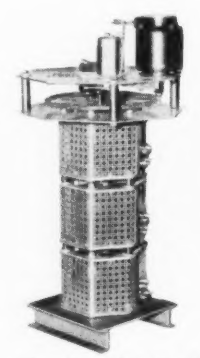
Write for Bulletin ER-108, which gives further information about Rectifiers and Controls, plus useful control application suggestions.



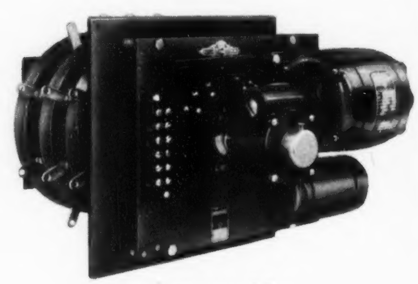
Manual Tap Switch Control



Saturable Core Reactor



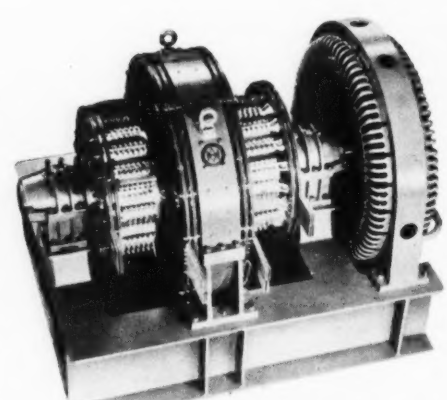
Continuously Variable Auto-Transformer



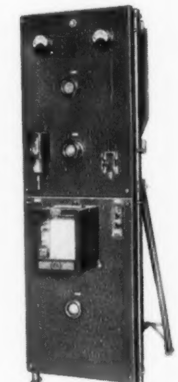
Motor Operated Tap Switch Control

Generators . . . and Controls

H-VW-M Motor Generators designed especially for metal finishing operations are built in sizes up to 50,000 amperes, and accessory equipment includes a full line of controls and control panels to cover any desired control function. Easy-to-maintain H-VW-M Motor Generators have exceptionally rugged and practical construction features insuring maximum performance and life. Standard voltage ratings range from 6 to 50 volts, and include the 18 and 24 volt units usually required for sulphuric acid anodizing, plus the 40 and 50 volt units used in chromic acid anodizing. Write today for 24-page Bulletin G-104, covering in detail all H-VW-M Generators.



15,000 Ampere, 6-Volt Generator Unit

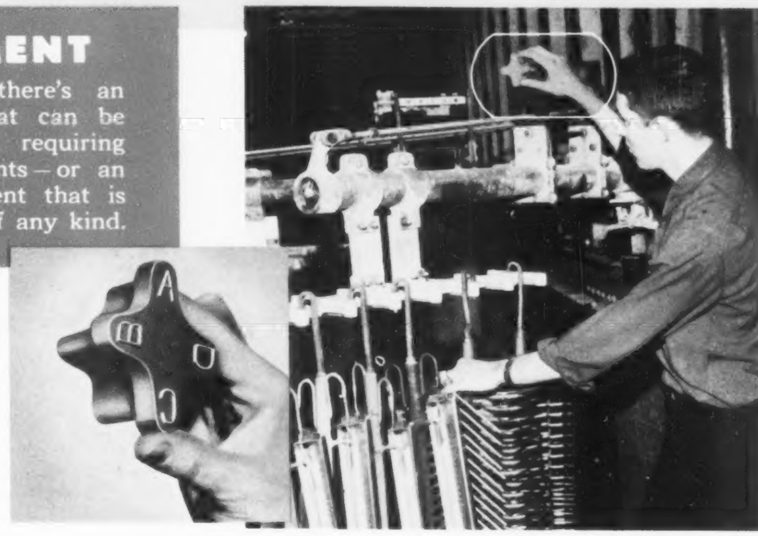


Automatic Anodizing Control Panel

Supplies, Equipment and Services Add Up Simplicity of Operation in Your Plant

PROCESSING EQUIPMENT

Whatever your anodizing procedure, there's an H-VW-M Full Automatic Conveyor that can be adapted to any production application requiring automatic cycling of individual treatments—or an H-VW-M Tank with accessory equipment that is perfectly adapted to still tank methods of any kind.



Workman "dials" desired cycle in refrigerator plant. Parts will by-pass or lower into baths as dial setting dictates.

Automation in Metalfinishing— *Full Automatic Conveyors with Dial-A-Cycle*

H-VW-M's new DIAL-A-CYCLE system automates nine or more complete metalfinishing processes on a single anodizing or electroplating machine. This revolutionary by-pass mechanism can be used on any metalfinishing installation for anodizing, electroplating, or similar processing. It is especially useful and effects substantial cost reductions when a variety of parts requires several different processes or colors.

DIAL-A-CYCLE, as the name implies, is controlled by a simple dial setting. The dial is mounted on the carrier arm that carries the parts through processing tanks. It is set by the machine operator for the processing steps through which each load of unfinished parts is to move. Automatic conveying then takes over, lowering the parts into the required tanks and bypassing others.

Different products, requiring different anodizing cycles, may be processed at the same time, with the same equipment. DIAL-A-CYCLE gives you new versatility while reducing operating, labor, and maintenance costs. Close, automatic control of transfer and immersion periods improves quality.

DIAL-A-CYCLE is the newest of many types of conveyors and equipment H-VW-M supplies to aluminum finishers. H-VW-M also design, manufactures, and installs return-type conveyors . . . elevator conveyors . . . straight-line conveyors . . . and others. For a complete description of all types, write for Bulletin FA-105.

Tanks and Equipment

At H-VW-M—the plating and anodizing industry's workshop—you'll find tank equipment for every phase of your work. For chromic acid anodizing, H-VW-M double electric welded unlined steel tanks are offered, along with steel coil equipment for cooling and heating. The entire system is H-VW-M designed, supplied and installed. For sulphuric acid anodizing, lead-lined steel tanks, plus the necessary cooling coils and air agitation assembly, are supplied. Tanks are fabricated from hot rolled steel, stainless steel, and aluminum. Other types of tanks are also available. Bulletin No. T-108 gives full particulars about this important H-VW-M equipment. Every conceivable type of auxiliary equipment is engineered and supplied, according to customers specifications, including a complete packaged refrigeration system for anodizing solutions.

And H-VW-M's Engineering and Installation Service

Anodizing problems of *any* kind? H-VW-M is prepared to set up your entire anodizing system from beginning to end—a system made up of components scientifically engineered to work together with utmost efficiency. Because of this, and because of H-VW-M's continuing research and development in every aspect of the anodizing picture, you can be confident that the recommendation you receive from H-VW-M is the very *best*.

What's more, if requested, H-VW-M sees to it that the equipment you buy is H-VW-M *installed*. This means perfect, efficient operation from the start.

Add to this the fact that an H-VW-M technical representative—ready to serve you—is no further than your telephone. These representatives serve in principal cities across the nation. Get to know the one nearest you. He can help you get the most from your aluminum finishing equipment and supplies.

TURN THE PAGE FOR ALUMINUM BUFFING AND CLEANING SUPPLIES

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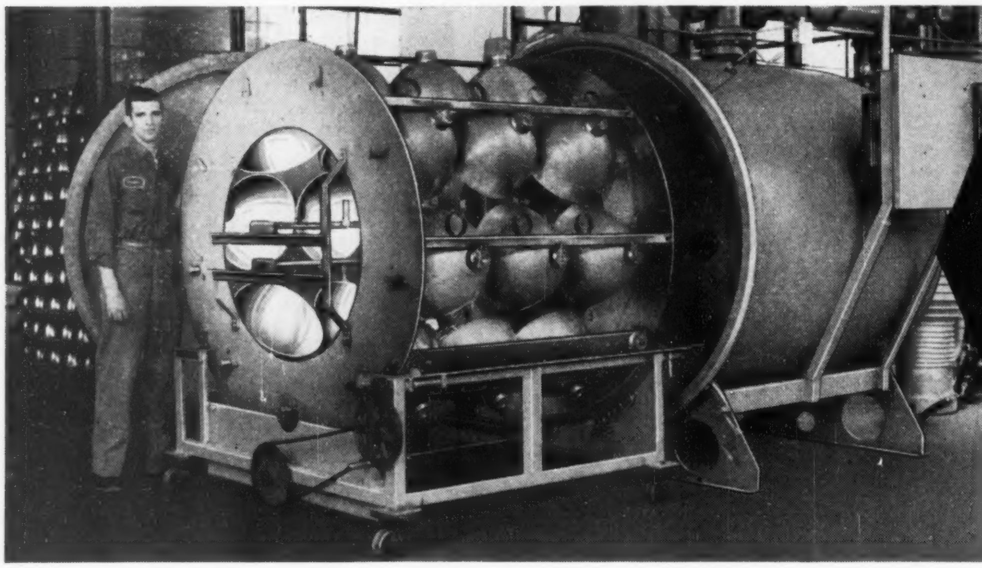
Should *You* Use

VACUUM COATING?

Would a Colorful Metallic Finish Add Sales Appeal to Your Product?
Do You Want a Metallic Finish on a Non-Metallic Product?
Would Vacuum Coating Cut Your Production Costs?



This NRC "Rapid Cycle" vacuum coater cuts unit finishing costs from $4.00 each to 95¢ each,

and, best of all, customers like the new product better.

NOW YOU CAN AFFORD COLOR

The gleaming, colorful metallic surface provided by vacuum coating is the answer to competitive demands for color where quality must be maintained, but pennies have to be pinched. Vacuum coating adds a bright shiny finish to metal, plastics and many other materials. The range of colors is virtually unlimited.

PRODUCTION SAVINGS

Buffing and polishing operations are eliminated. Inexpensive base materials can be used. There is no need for skilled operators.

THE GUESSWORK IS GONE

From experience in all phases of vacuum coating, we know that, spectacular as it is, vacuum coating is no cure-all. Tell us what you are processing now, and let us tell you whether you can benefit from this technique. If vacuum coating can help you, we'll supply you with vacuum-coated samples of your own product, in a selection of colors so that you can evaluate them for performance and sales appeal. We'll give you production rates and unit costs for coating your product. Provide a complete system engineered to your requirements. Install it, train your operators and stay on the job until it is *operating to your satisfaction.*

Send us the story on your operations today, or use the coupon to get more information.

We Need
FIVE ENTHUSIASTIC ENGINEERS
To Help Us Keep Growing.
Mechanical, electrical and chemical engineers who honestly enjoy solving novel problems in brand new fields are offered new responsibilities and more stimulating work. Write Mr. David Tobin or call De 2-5800.

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NRC EQUIPMENT CORPORATION
A Subsidiary of
NATIONAL RESEARCH CORPORATION
Dept. 1311, Charlemont Street, Newton Highlands 61, Mass.
Please send me the "Rapid Cycle" Vacuum Coater Bulletin

Name........................ Title..............
Company..
Address..
City.................. Zone.... State..............

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Colson adds More Proof

PLATING COSTS DOWN

. . . from 80 hours a week to 16. That's what Colson gains by using perforated tumbling barrels in plating. It's Colson's new way of plating caster parts with cadmium and zinc. It pares costs 45 to 66%.

New way — Five perforated, hexagon welded plastic barrels replace baskets. Each barrel is suspended in the tanks by a heavy steel bracket and is rotated by a drive unit at 2½ rpm.— fast enough to give excellent coverage but not so fast that parts are nicked. An electric chain hoist moves barrels from tank to tank.

Old way — Operation was a bottleneck. Parts were loaded into baskets, then dipped in a series of six tanks. Neither the work nor the solution was agitated, so coverage wasn't uniform. Repeat treatment was needed often.

Barrel cuts plating time 80%

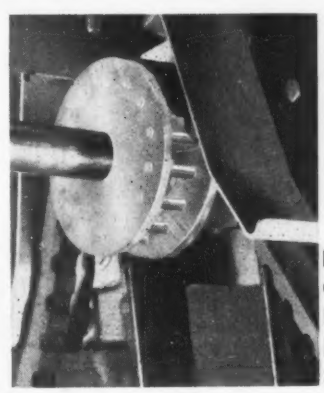
(above) Reprinted courtesy Factory Management and Maintenance, July, 1956, Page 94, "Putting Big-Time Ideas to Work" (at Colson Corp., Elyria, Ohio)

that G-S means Greater Savings

Colson Switched to G-S Belt-Drive Barrels . . . Cut Time, Costs and Improved Quality

"When a production man can see a way to save manhours, and money while producing a better product, he's always interested" said Jack Davis, Plant Manager of Colson Corp., Elyria, Ohio. "We changed over our plating line to G-S Barrels for cadmium and zinc. Now, after 3 years, our figures show man-hour savings, and practically no maintenance costs or replacement of equipment.

Colson typical of all G-S installations! . . . G-S "Cogged-V-Belt" Drive Plating Barrels offer platers larger loads, faster, better plating at higher current densities. They deliver "through cycle" service, and longer equipment life with no down-time. No other equipment can match G-S feature-for-feature at any price. (U. S. Pat. 2,562,084. Other Pats. Applied For.) That's why G-S equipped platers are getting the biggest returns per investment in the industry. Check into the G-S Conversion Plan for **your** plant. It costs **less** than you think, and will **pay for itself in savings.**



SAVE 100%

gear maintenance

Eliminated: cylinder end drive gear, idler gear, pinion gear, 3 bearings.

No gears or bearings in solution.

"The Belt-Drive with the Gear Grip" — Exclusive G-S cogged V-belt and cogged drive-pulley, constant meshed for positive power transmission without gears. Can't slip, creep, vary speed. Cogged-V-Belts steel tensile members won't stretch. "Locking U-Hubs" — danglers angled down through hubs won't ride up on load. Quick, easy changing of cylinder and danglers saves hours. Adjustable Bearings, Floating End Plates for constant contact. Total cylinder immersion prevents explosions. Cylinders of H-T Sincolite or Tempron (hard rubber) fusion-welded, heavy-ribbed construction. See more features than ever before offered. Send for Bulletin GSB 101.

The G. S. Equipment Co.

5317 St. Clair Ave., Cleveland 3, Ohio

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STATEMENT REQUIRED BY THE ACT OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946 (Title 39, United States Code, Section 233) SHOWING THE OWNERSHIP, MANAGEMENT, AND CIRCULATION OF METAL FINISHING, published monthly at Westwood, New Jersey, for November 1, 1956.

1. The names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Finishing Publications, Inc., 381 Broadway, Westwood, N. J.; Editor, L. H. Langdon, 381 Broadway, Westwood, N. J.; Managing editor, Nathaniel Hall, 381 Broadway, Westwood, N. J.; Business manager, Thomas A. Trumbour, 381 Broadway, Westwood, N. J.

2. The owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address as well as that of each individual member, must be given.) Finishing Publications, Inc., 381 Broadway, Westwood, N. J.; L. H. Langdon, 275 Engle Street, Englewood, N. J.; Palmer H. Langdon, Closter, N. J.; Louise H. Hasselback, 14 Westmoreland Road, Alexandria, Va.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of the total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: (This information is required from daily, weekly, semiweekly, and triweekly newspapers only.)

THOS. A. TRUMBOUR, General Manager.

Sworn to and subscribed before me this 17th day of October, 1956.

W. R. CHAPMAN

(Seal) (My commission expires June 27, 1960)

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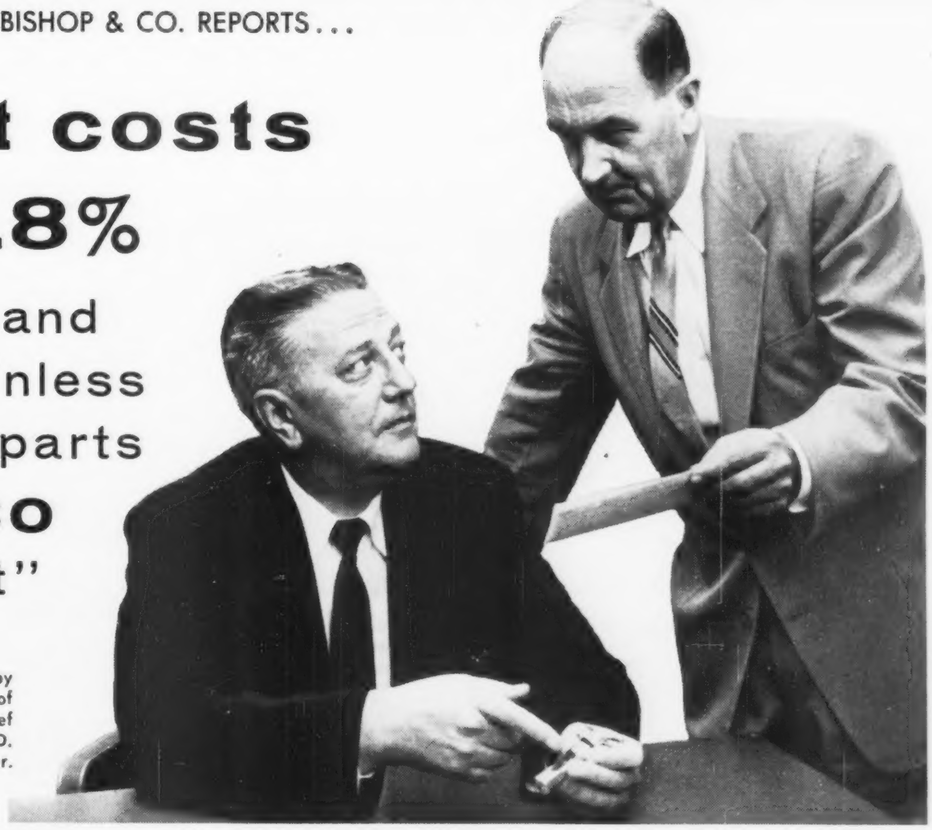
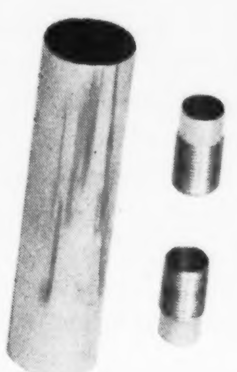
THE CHIEF ENGINEER OF J. BISHOP & CO. REPORTS...

"We cut costs 98.8% by deburring and polishing stainless steel tubular parts with ALMCO equipment"



SAVINGS OF $6,917.50 PER YEAR by controlled barrel finishing is the topic of discussion between J. H. Gettig, Chief Engineer of J. Bishop and Co., and O. D. Ladley, Almco Eastern Branch Manager.



HALF A MILLION delicate parts for recording instruments and fountain pens are deburred and polished each year at J. Bishop & Company of Malvern, Pennsylvania. Each must meet rigid requirements in uniformity of size, smoothness and high polish.

A costly process? Yes, when you consider the way Bishop used to finish them by machine reaming, hand scrapers, wire brushes and belt polishers.

Today this plant uses an Almco Model DB-200 finishing barrel, which gives three important advantages: (1) High volume, low cost deburring and finishing, (2) precise control during finishing process, (3) product improvement.

Here's how controlled barrel finishing worked out for J. Bishop & Company. They cut finishing costs by 98.8% ... practically eliminated rejects ... raised average output from 200 parts to 6000 parts per hour. Cost per unit for finishing has been cut from .014¢ to .00016¢. Annual savings total $6,917.50.

Chief Engineer J. H. Gettig sums it up this way, *"Our decrease in costs and our product improvement leaves no basis for comparison."*

PART OF A HALF MILLION ANNUAL OUTPUT, this batch of delicate instrument parts is being run in an Almco DB-200 barrel finishing machine.

Almco equipment is also used throughout the world for descaling, grinding, work-hardening, rust-inhibiting and other deburring and finishing operations. Equipment is available for small and large parts, high or low volume work. Each is designed to handle ultra-low microinch surfaces and close tolerance radii.

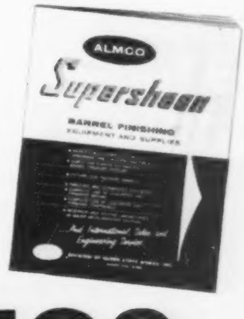
LEARN HOW MODERN BARREL FINISHING CAN IMPROVE YOUR PRODUCT

Almco's new, technician-staffed lab in Albert Lea, Minnesota can help you with your product parts. We will examine your product parts, run them through tests, and come up with the answers you want. For example—where you can save finishing costs, how you can improve product quality and appearance, what method is best for your operation.

Why not send us your sample parts? Enclose specifications on the results you want. Or write us on your company letterhead requesting an Almco engineer to call on you.

SEND FOR YOUR FREE HANDBOOK ON BARREL FINISHING

52 pages of facts and processes on barrel finishing. Shows typical installations, how to select the proper finishing barrel. Includes detailed cost chart on finishing of typical parts. Send for your free copy today.



ALMCO

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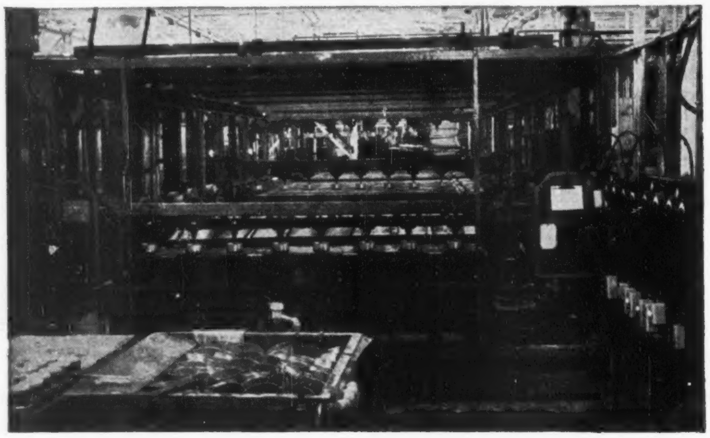

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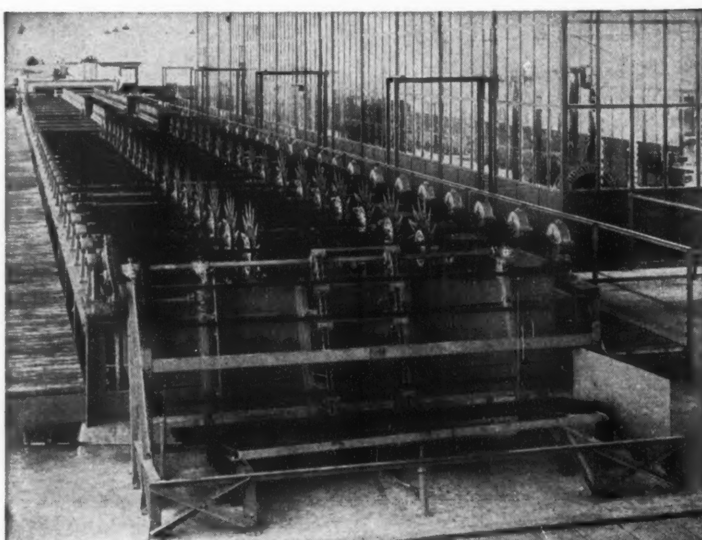

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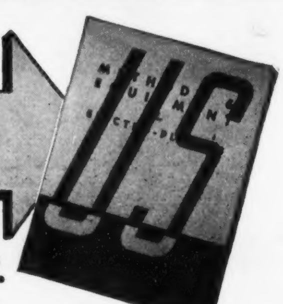

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METAL FINISHING

DEVOTED EXCLUSIVELY TO METALLIC SURFACE TREATMENTS

NOVEMBER, 1956 Volume 54 Number 11

FEATURES

DEPARTMENTS

Published Monthly By
Finishing Publications, Inc.
Established in 1903 as Metal Industry by Palmer H. Langdon 1868-1935.
Also publishers of ORGANIC FINISHING and
annual GUIDEBOOKS and DIRECTORIES.
381 Broadway, Westwood, N. J.
WEstwood 5-1530

L. H. Langdon, *President-Treasurer;* Palmer H. Langdon, *Publisher;* Thomas A. Trumbour, *General Manager;* Joan T. Wiarda. *Sales Manager;* Nathaniel Hall, *Technical Editor;* Fred A. Herr, *Pacific Coast Editor;* John E. Trumbour, *Equipment & News Editor;* Inez Oquendo, *Assistant Editor;* Elizabeth Meyers, *Circulation Manager.*

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SUBSCRIPTION INFORMATION

United States and Canada $4.00 per year, other countries $8.00. Single copies 45c in United States and Canada, other countries 85c. GUIDEBOOK-DIRECTORY 25th edition 1957 current, over 600 pages 5¼x7⅞, subscriber's edition $2.00 per copy, deluxe edition $3.50 per copy. Please remit by check or money order; cash should be registered. Request for change of address should reach us on or before the 15th of the month preceding the issue with which it is to go in effect. In sending us your change of address, please be sure to send your old address as well as the new one. It is difficult and often impossible to supply back numbers. Contributed articles, letters on pertinent subjects are invited. Their publication, however, does not necessarily imply editorial endorsement. Re-entered as second class matter June 13, 1940 at the post office at New York, N. Y. under the Act of March 3, 1879.

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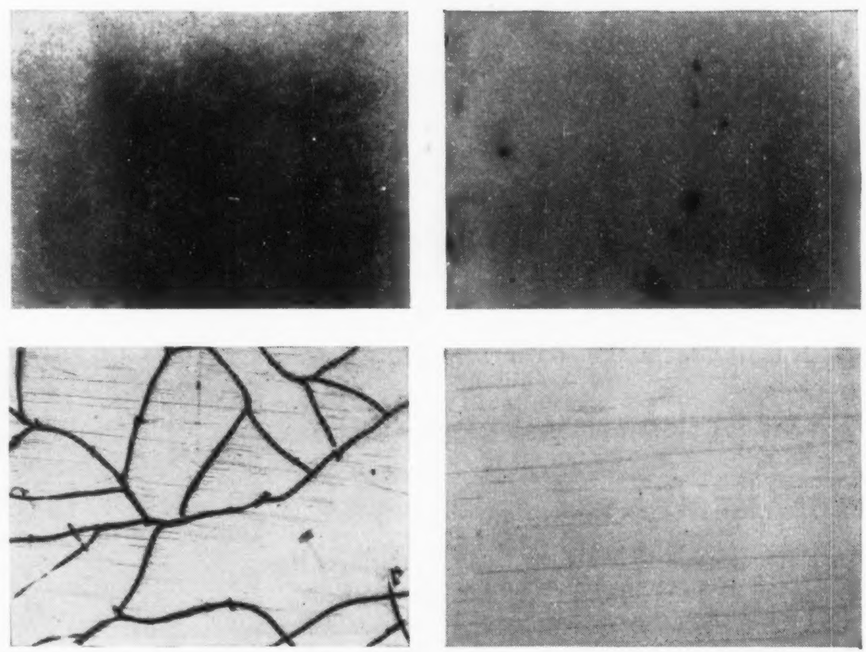

Top: (Left) After many months outdoors, a .0005" deposit of ordinary chromium, plated directly on steel, was rust-covered; (Right) Crack-Free Chromium, same thickness, was virtually unaffected. Bottom: (Left) Photomicrograph of etched ordinary chromium shows network of microscopic cracks. (Right) Etched Crack-Free Chromium deposit shows no such imperfection.

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METAL FINISHING

DEVOTED EXCLUSIVELY TO METALLIC SURFACE TREATMENTS

ESTABLISHED 1903 VOLUME 54 • NUMBER 11 • NOVEMBER, 1956

It May Lead to Something, After All

Regular patrons of this page probably are aware of one editor's opinion of the salt spray as an acceptance test. For the benefit of those who usually turn this page fast, we repeat: We never thought much of the test in the past, we don't like it now, even with the modifications which unquestionably are an improvement and must admit that, even if it is improved a lot more, we still won't like it. Call it prejudice, if you will, but this dislike is based on a good many years of operating a salt spray chamber and contending with all its vagaries.

Although we often find ourselves a very vocal minority of one, in this case we know we speak for a significant segment of the industry. Frankly, our sympathies are with the small operator of whom, like the poor, the Lord made many. The salt spray test will always be, intrinsically, one which is costly to install and operate properly. The results will always be susceptible to manipulation, and the possibilities of litigation are manifest.

Of course, there is another side to the picture. Government procurement agencies and large manufacturers who sub-contract some of their components must have some acceptance test and, in the absence of a suitable alternative method, we may expect a continued dependence on some modification of the salt spray test. Work has been in progress, continuously, along the lines of improving its reliability, broadening its scope, and accelerating its action, especially the first. Those finishers who have occasion to specify performance tests, who are called upon to meet such tests by their customers, or who operate their own salt spray units for comparative purposes, will find very rewarding the evaluation of recent modifications, graciously prepared at our request and presented in this issue of METAL FINISHING by *Wardley D. McMaster* of General Motors Corp.

The wide variation of plating quality pointed out by the author, even among parts produced in the same solution at the same time, is something which will give pause to all platers who have occasion to plate to specification. This matter has been a continual source of concern to proponents of salt spray and other suggested performance testing because, obviously, it is not possible to set up effective production finish performance standards without a standard, reproducible finish upon which to base them. Staring us in the face is the stark fact that, after all these years, we still cannot produce a consistent finish because we haven't discovered enough about plating to know what we are doing! It may turn out that these investigations of the salt spray test will have the result of disclosing the secret which will transform the art of plating undeniably into a science.

Nathaniel Hall

Accelerated Testing of Metallic Surfaces

The Salt Spray Test and Its Modifications

By Wardley D. McMaster, *Assistant Head, Chemistry Dept., Research Staff Division, General Motors Corp., Warren, Mich.*

THIS article is specifically addressed to those readers of METAL FINISHING who do not normally come in contact with ASTM publications of the electroplating industry. It is not intended to be a complete record. The background material will be found in the ASTM Literature.[1] A significant bibliography is part of the ASTM publication.

The Twenty Per Cent Neutral Salt Spray

The neutral salt spray has been used for many diverse purposes, and has been misused for as many more. The 20% concentration was widely used at one time, and became the accepted standard because its principle proponents were in a favorable position as a result of superior operating techniques, and as active members of ASTM Committee B-3. The 20% neutral salt spray, when operated under optimum conditions, is quite satisfactory as a tool for evaluating various types of corrosion resistance or weather resistance involving organic coatings with or without a phosphate base. It was also applicable to the testing of plated coatings of zinc for porosity and thickness, and plated ware in general for existent gross porosity. It was not applicable to the evaluation of cadmium plated items, and the blistering of plated zinc-base die castings. It was questionable for the evaluation of anodized or phosphated aluminum, or the weather resistance of decorative chromium plated parts such as are found on automobiles (Fig. 1).

It was a fact, however, that the 20% concentration was too low in humidity for best results in testing organic coated metal parts. It was also a fact that, being near saturation, dry spray and clogged nozzles were the rule rather than the exception, and gave rise to erratic results. A third factor, resulting in major disagreements between supplier and purchaser, is the excessively wide range of collection rate specified. This is from 0.5 ml. to 3.0 ml. of condensate per hour per 80 square centimeters of horizontal exposure area, a ratio of 6 to 1. This weakness has been adequately demonstrated, and a more realistic range of 1.0 to 2.0 ml. has been standard in General Motors and many other firms for 10 years. This new range has been proposed to ASTM and is on the agenda for consideration by the committee. With all of these operating problems unsolved, it is no wonder, then, that many have felt that the salt spray was not a good acceptance test.

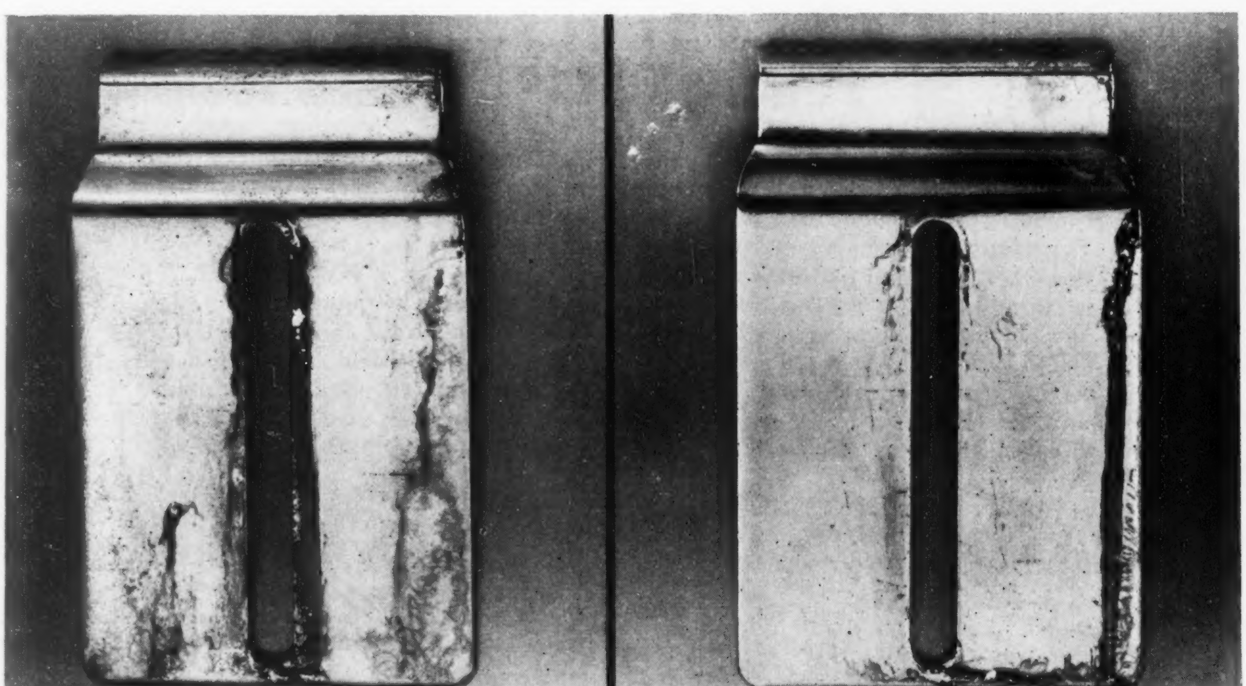

Figure 1.

Half Standard Plate.
Regular Salt Spray 500 Hours.

Standard Plate.
Regular Salt Spray 500 Hours.

The Five Per Cent Neutral Salt Spray

The five per cent neutral salt spray is now the tentative ASTM method B-117-54T; and is in the process of being adopted, over a period of time, by the Government departments. When it is used, any technician properly instructed and reliable can obtain results that may be used as acceptance tests, provided the collection rate is held between 1 and 2 ml./hr./80 sq. cm. and the other requirements met. It is useful for organic coatings of all kinds over treated and untreated steel, for zinc, and for untreated aluminum. It may be used as an accelerated acceptance test in many cases where the actual exposure involves no salt, provided there is a definite service experience that justifies it. Thus oily or waxy corrosion inhibiting coatings for steel may be evaluated in an accelerated manner, since there are ample data available which indicate very satisfactory agreement between the salt spray and service experience. There will be no nozzle clogging by salt using this method, but the nozzle passages must be cleaned at intervals, depending on the efficiency of the filters used.

In the light of these statements, it is suggested that emphasis be placed on comparative results, using a proven material as a standard. It may be possible to determine that X hours in salt spray may be equivalent to Y months in Z service, yet it is folly to expect such a ratio to be valid for types of service other than Z, or even for minor variants of Z. On the other hand, it is fatuous to check coatings or treatments that offer negligible protection, by using such an accelerated test, when we well know that their service life depends almost entirely on chance variations in normal conditions. Even so, it may be possible to determine the relative merit of two different treatments.

The Acid Salt Spray

The acetic acid salt spray, ASTM B-287-54T, is simply a modification of the neutral salt spray, attained by the addition of sufficient acetic acid to produce a pH of 3.2 $\pm$ 0.1 in the condensate obtained in determining the ASTM collection rate. It is neither "critical" nor "expensive" in operation. Since it is an accelerated test, wide variations in temperature, humidity, collection rate, angle of the test item, and pH, cannot be tolerated. Adequate control can be obtained through normal laboratory good housekeeping, once the box design[2] has been established as satisfactory and, thus, is no more difficult than adequate control of the neutral salt spray.

This test is recommended for the evaluation of the thickness and general quality of both zinc and cadmium plate, (Table I), of nickel-chromium plate on steel, of copper-nickel-chromium plate on steel, (Fig. 2) (Table III), on zinc-base die castings, (Table II), and for the evaluation of surface treatments of aluminum and its alloys. Other similar uses may be developed. In addition, the acid salt spray test *may* be used

TABLE I

Comparison of Zinc and Cadmium Plated Steel in the Acetic Acid Salt Spray at 95°F.

Plate Thickness, mil	Hours to Failure	
	Zinc*	Cadmium
0.15	10	8
0.30	24	16†
0.50	48	24†

*Approximately 50 per cent faster than plain salt spray.
†These plates do not fail in plain salt spray.

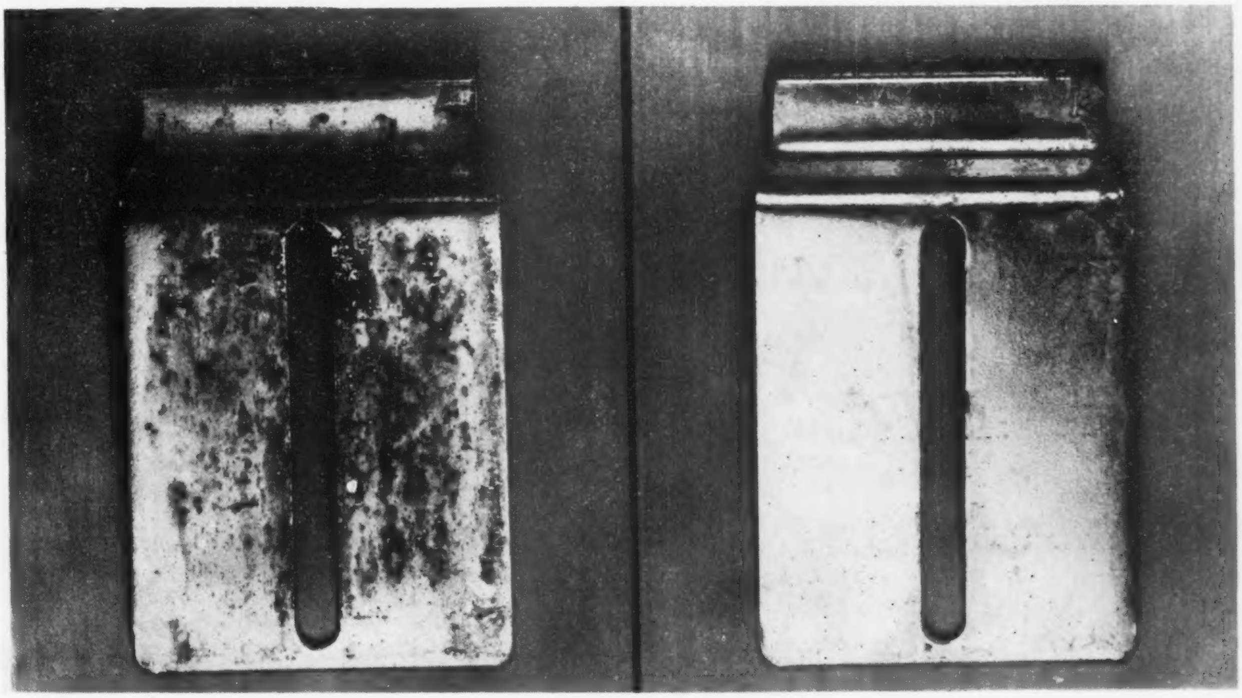

Figure 2.

Half Standard Plate.
Acetic Acid Salt Spray 240 Hours.

Standard Plate.
Acetic Acid Salt Spray 240 Hours.

TABLE II

Plated Zinc Base Die Castings in Acetic Acid Salt Spray

Film Thickness	*Standard 1.485*	*Substandard 0.655*
Copper	0.35	0.20
Nickel	1.13	0.45
Chromium	0.005	0.005
Hours to failure by Blistering		
95°F.	60	30
120°F.	35	16

TABLE III.

Chromium Plating in the Acetic Acid Salt Spray

Film Thickness of Good Quality Plate	*Hours to Failure by Scattered Rusting*	*Estimate of Failure-Free Life on Car, in Winter, Detroit*
0.0001 inch	8	1 week
0.0002 inch	16	2 weeks
0.0003 inch	32	4 weeks
0.0005 inch	72	8 weeks
0.001 inch	168	20 weeks
0.0015 inch	240	1 year
0.003 inch	750	3 years

for nearly all testing now done in the neutral salt spray. New specifications must be written for most tests, as the acetic acid salt spray is much more accelerated than the neutral salt spray. This difference appears to be about 1200% in the case of copper-nickel-chromium plate on steel.

The novice using the acetic acid salt spray is usually dismayed by his inability to check the results obtained by other laboratories, even when good housekeeping procedures have been established. This arises from two independent factors.

1. The element of human judgment applied to the evaluation of the degree of failure of a part.
2. The wide variation of plating quality, even between parts produced in the same bath at the same time.

The variable of human judgment may be practically eliminated by training and experience, or by the use of a transparent plastic with a ruled grid making 100 squares covering the significant area. The number of squares containing one or more corrosion induced defects other than staining or run-down from other areas, serves to yield a "percentage of area affected" figure to be applied to the following table.

Extent of Failure	*Rating Number*
No basis metal failure	5
0-10% of area	4
10%-30% of area	3
30%-70% of area	2
70%-100% of area	1

For research purposes, inspections are made each 24 hours to a total of 192. The rating numbers for each inspection are added, multiplied by 2.5, and the result called the "Performance Index Number" or "P.I.N.)) This number obviously varies between 20 and 100. Variations of this system to reduce the number of inspections and/or increase the numbers of hours of exposure, may be adopted as the need arises.

The variable of plating quality seems to come as a surprise to most people. It is possible that the lack of a sensitive laboratory test has masked the wide variations now being pin-pointed by the acetic acid salt spray. However that may be, it is now clear that the test is more controllable than the production to be examined. Even our well-controlled plating operations

TABLE IV. *Combined Results — GM Accelerated Weathering Sub-Committee Round Robin Test — Acetic Acid Salt Spray — Performance Index Method*

Testing Laboratory	*1*	*1-A*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*All Pieces*
Zinc Base Die Castings											
Number in Sample	42	12	16	11	11	11	11	11	11	136	73.2
Average P.I.	72.4	69.4	72.3	69.5	59.3	75.0	85.9	73.4	68.9	74.7	97.5-27.5
Range	92.5-27.5	97.5-55	85-45	85-55	92.5 32.5	92.5-47.5	95-82.5	90-40	85-60	95-60	—
∝	14.9	13.7	10.2	9.5	19.0	12.8	3.9	15.7	9.41	11.0	
Steel Panels											
CODE 50						—					55
Number in Sample	11	-	8	6	6	—	6	6	6	6	63.0
Average P.I.	60.2	-	68.1	54.6	52.1	—	77.9	74.6	62.9	53.8	85-22.5
Range	85-22.5		80-52.5	70-47.5	60-40	—	82.5-65	82.5-50	65-62.5	65-37.5	—
∝	16.3	-	8.9	9.9	6.9		6.4	11.5	1.7	8.3	
CODE 100											55
Number of Sample	11	—	8	6	6	—	6	6	6	6	77.5
Average P.I.	72.7	—	75.6	79.2	75.4	—	86.7	77.1	89.6	68.3	97.5-30
Range	97.5-30	—	80-60	82.5-72.5	87.5-52.5	—	92.5-82.5	87.5-62.5	95-85	77.5-52.5	—
∝	19.2	—	7.7	3.3	5.6	—	2.0	8.4	4.3	8.3	
CODE 150											55
Number in Sample	11	—	8	6	6	—	6	6	6	6	87.4
Average P.I.	90.7	—	85.6	84.6	80.0	—	88.8	87.1	95.4	85.0	100-57.5
Range	100-80	—	100-70	100-57.5	90-62.5	—	92.5-85	90-85	100-90	90 77.5	—
∝	6.5	—	9.2	14.6	9.1	—	1.03	0.2	5.0	4.3	

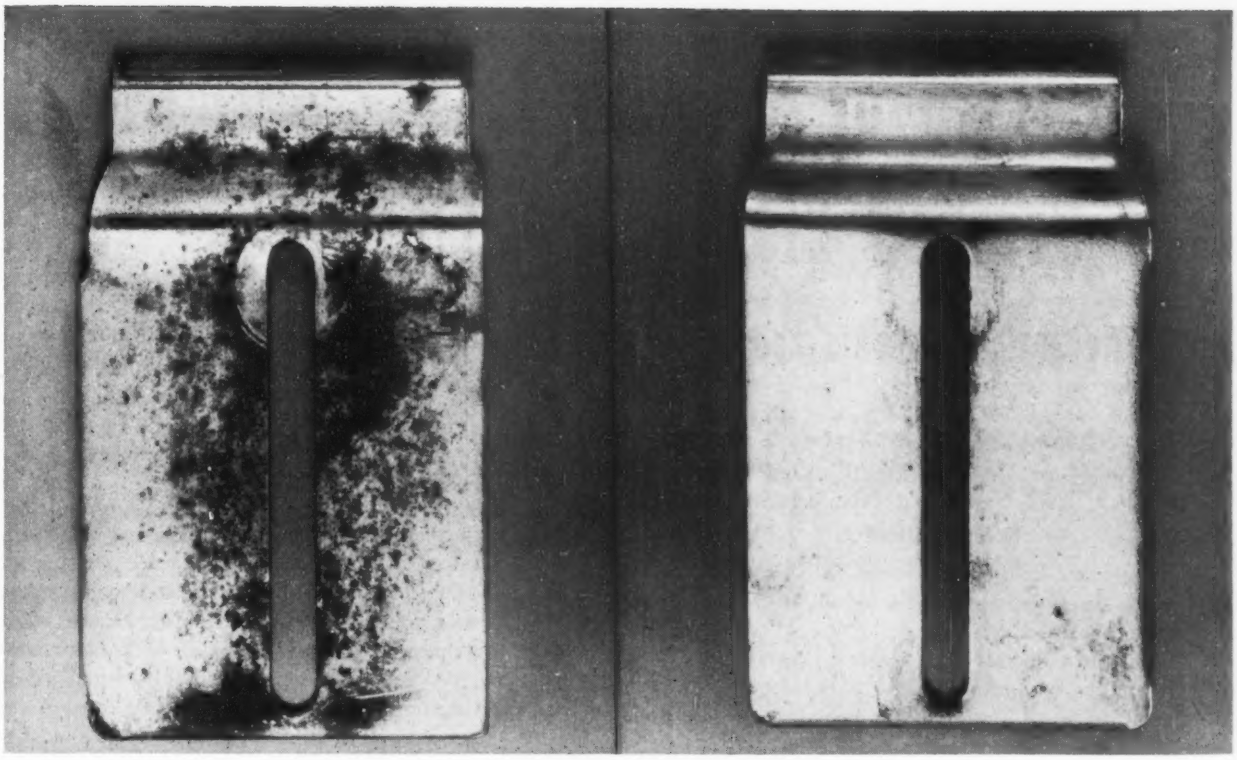

Figure 3.

Half Standard Plate.
One Winter on Car — Detroit.

Standard Plate.
One Winter on Car — Detroit.

seem to be incapable of producing a uniformly corrosion resistant plate. It has been determined that no less than 10 samples of a lot must be taken and the ratings averaged, to obtain a value for the P.I.N. that will be within ± 5 of the number obtained by averaging 50 to 100 samples. Such a result is quite satisfactory for an acceptance test or even for research on the plating bath.

Cooperative tests planned to determine the repeatability and reproducibility have just been completed. The accompanying tabulation shows that the results lie within the confidence limit of ± 5 P.I.N. for the 11 samples of plated zinc die castings, and within the limits of ± 10 for the 6 steel base plated parts. The repeatability tests are not shown in full, but are indicated under Lab. No. 1 and 1A. Since this work was done entirely on the basis of written instructions, the results are quite significant (Table IV). The zinc-base die castings were plated to code 150. The code numbers express the total plate thickness in hundred thousandths of an inch. Laboratory 4 used an acid-salt solution contaminated with iron. Laboratory 6 had too high a pH in the settling "fog." These variations seem to account for their variance from the normal.

The industry has not yet reached a point where acceptable specifications can be written, or if written, where they can be met on a large scale. If a part will go through a winter in Detroit on an automobile without any rust, it is considered rather good (Fig. 3). It is believed that the increased demands of production since 1945 have forced many unproven changes in plating formulation and procedures. Certainly, the acetic acid salt spray can be of value in the study and refinement of the operations.

Data available to date suggest that a P.I.N. in the neighborhood of 125 should insure complete freedom from corrosion of a part installed on the average Detroit automobile for one year. It is estimated that the average P.I.N. of production parts during 1955 was about half that suggested figure. Since Detroit exposures are believed to be the most severe in the country, it might be held that it is sufficient to provide a plating quality that will be acceptable to 75 or 80% of the population. Detroiters hope not.

Assuming a realistic system of control for production operations, one would naturally conclude that a 200-hours test should not be out of the way as an indication of a drift in the quality of the product. It is obviously too long for a certification test of daily production, or of production without controls. If production is to be good one day and bad the next, it is obvious that the volume of acceptable items will not meet demands, the parts will be shipped anyway, and the cry for a more rapid test is so much whitewash. The mate to this shoe fits the consumer equally well. In spite of this, it is agreed that a more rapid test would be desirable.

More Highly Accelerated Tests

There are several means of accelerating the testing of plated parts. One of them has been known for many years, but not much used, because at most, it halves the time required. The others have not been fully investigated, though preliminary tests indicate that they have merit.

C. F. Nixon, who first proposed an acetic acid salt spray in 1945,[3] did so on the basis of maintaining a

(*Concluded on page* 55)

Production of Smooth, Fine-Grained Electrodeposits

Some Theoretical Aspects and Principles

By Gunner Gabrielson, *Ab Tudor, Nol, Sweden*

Introduction

IN the past few decades, the metal finishing industry has gone through an enormous development, from a technical as well as economical point of view and, nowadays, most metal goods receive some surface treatment during manufacture, the purpose of which is usually twofold: to improve the appearance and to afford protection against corrosion.

The technical development has progressed along two lines. First, the sizes of the electroplating plants have been increased enormously and the coatings are applied in continuous processes. Second, the concentration of the depositable metal in the electroplating baths is much higher than it was only twenty years ago, and thus permits the deposition to proceed at a much faster rate than before. In this connection it must also be emphasized that the control of the electroplating solutions at present is much more thorough than before, through chemical analysis, pH-determinations, and small scale laboratory depositions, e.g. by means of plating cells.

It is the aim of this paper to study in some detail those principles of the electrodeposition which explain how it has been possible to increase the rate of metal deposition from electroplating baths, an increase which is so striking when we consider the metal finishing industry twenty years ago.

Metal Concentration in Old and Modern Baths

The compositions of the electroplating solutions used about twenty years ago differed considerably from the compositions used today. As a typical example, the composition of the Watts nickel plating bath, taken from the literature,[1] may be quoted:

Nickel sulphate ($NiSO_4 \cdot 6H_2O$)	200 g./l.
Nickel chloride ($NiCl_2 \cdot 6H_2O$)	45 "
Boric acid (H_3BO_3)	30 "

The modern Watts formula is more concentrated, the composition being represented reasonably well by the following:[2]

Nickel sulphate ($NiSO_4 \cdot 6H_2O$)	300 g./l.
Nickel chloride ($NiCl_2 \cdot 6H_2O$)	60 "
Boric acid (H_3BO_3)	38 "

Deposition of metals from the older baths occurred at a rather low current density, lower than necessary with regard to the metal concentration, owing to the fact that, in general, deposition occurred at relatively low temperature from solutions which were not stirred. By and by one learned that the current density could be increased appreciably if the plating baths were heated and the solutions were stirred, without obtaining burned deposits. One also found that, when using heated and stirred solutions, it was possible to increase the metal concentration in the plating baths and still get smooth, fine-grained, adherent deposits.

In this connection, it must be pointed out that the presence of a large number of metallic ions is not a favorable condition for producing smooth, fine-grained, metallic deposits. In this case, each deposited crystal of metal would be surrounded by a large number of metal ions, causing it to grow rapidly by the passage of the current. The result is a deposit with coarse-grained crystals. If, on the other hand, fine-grained deposits are desired, the conditions must be unfavorable to the growth of a few crystals, but must foster the formation of a large number of smaller crystals. This condition is fulfilled when there are only a few metal ions in the solution, so that an individual crystal does not have many ions adjacent to it to permit its growth.

The metal ion concentration can be reduced by using a very dilute solution. As has been shown above, this is a very unsuitable method, as a very low current density must be used in order to avoid burnt or spongy deposits. The solution ought, therefore, to contain only a few metal ions, but a large amount of dissolved metal salt, which permits a high current strength and furnishes a fresh supply of ions as fast as they are discharged and deposited. Under these conditions, the deposit will be smooth and fine-grained. For this reason, one of the most important types of plating baths is that where the chief constituent contains a complex metal salt like cyanide salt, e.g. copper, zinc, or cadmium cyanide solutions. As an example of the low metal ion concentration in this type of bath, it may be mentioned that, in a potassium copper cyanide solution, the concentration of free copper ions is only 10^{-21} grams per liter, when an excess of potassium cyanide is present, as in cyanide copper plating baths.[3] This is due to the fact that the complex copper cyanide ion is dissociated to only a very slight extent according to the formula:

$$Cu(CN)_3^{=} \rightarrow Cu^+ + 3CN^-$$

Another way of reducing the metal ion concentration of any salt solution is to add a substance with a common ion, e.g. by adding sodium sulfate to a copper sulphate solution. The reduction in metal ion concentration is, in this case, however, less marked than through the addition of complexing compounds.

It can be stated, generally, that polarization increases more rapidly in solutions with a low metal ion concentration, e.g. in complex cyanide baths, than in simple salt solutions. This means that, generally speaking, the crystal size decreases with increasing cathode polarization.

The possibility of getting a smooth, adherent, fine-grained coating, when the current density and the metal concentration are high, depends therefore on the metal ion concentration in the vicinity of the growing crystals in the so-called cathode film being maintained at a low but constant value, depending on the current density used. In this paper the different factors, which influence the depletion of the cathode film, are examined in some detail.

The Cathode Film

When an electrical current passes through a metal salt solution between two electrodes, the metal ions (and the hydrogen ions) move towards the negative electrode, the cathode. The metal ions are discharged and deposited when they reach the cathode surface. As this metal deposition occurs from that part of the solution which is in contact with the cathode, the concentration of depositable metal ions in this thin layer adjacent to the cathode, the cathode film, is lower than in the bulk of the solution, i.e. the cathode film is partly depleted. Consequently, there is a concentration gradient in passing from the electrolyte to the cathode. This is graphically presented in Figure 1, from which it is seen that the concentration of the ions to be deposited in the cathode film sinks from that of the bulk of the solution to zero at the cathode surface.

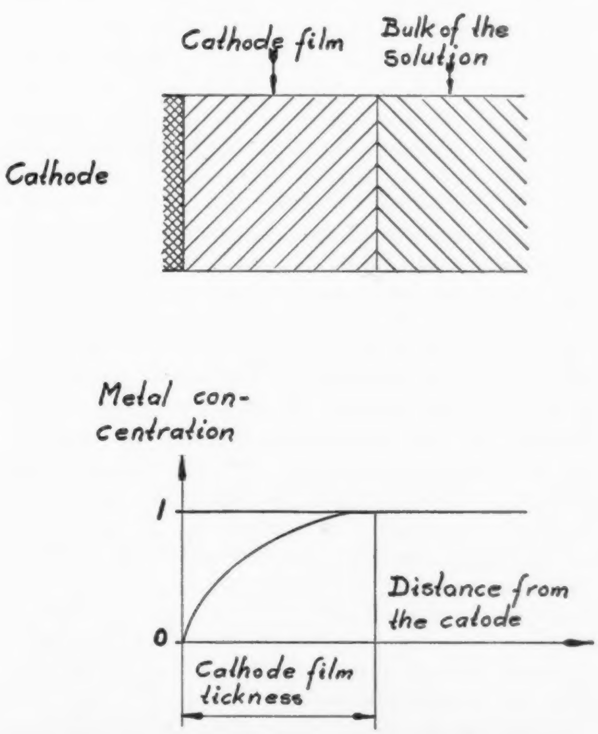

Fig. 1. Concentration of metal ions in cathode film.

Many experimental methods have been tried, in order to determine the thickness of the cathode film. Agar[4] found an average value of 0.05 cm. for vertical surfaces in unstirred solutions and 0.005 cm. or less in stirred solutions, depending on the rate of stirring, whereas Lewich[5] reported a cathode film thickness of 10^{-3} — 10^{-6} cm., depending on the rate of stirring. Kortüm and Bockris[6] also state the value of the film thickness to be 0.05 cm. in unstirred aqueous solutions, this value being reduced to 0.001 cm. by vigorous mechanical agitation. In comparison with the effect of mechanical agitation the effect of temperature on the film thickness is relatively small. In this connection it may be mentioned that, recently, the effect of ultrasonics in electroplating has been described in the literature.[7] It is seen that ultrasonic irradiation has the same effect on the cathode film as mechanical agitation i.e. the film thickness diminishes.

From the above, it is seen that the cathode film thickness, according to our present state of knowledge, lies between the limits of 0.05 cm. in unstirred solutions and 0.005 cm. or less in stirred solutions. Through mechanical agitation it is possible, therefore, to reduce the thickness of the cathode film at least 50 times. The consequence of this will be shown later.

The Limiting Current

The limiting current, often denoted I_L, means the maximum value of the current for the deposition of a single ionic species. A more detailed investigation shows that the magnitude of the limiting current is given through the formula:

$$I_L = \frac{R}{z \cdot F} \cdot \frac{\lambda \cdot T \cdot c}{\delta}$$

(equation 1)

where R is the gas constant = 8.313 joule
F is the Faraday = 96,500 coulombs
z is the valency of the ion
λ is the equivalent conductance of the ion
T is the absolute temperature
c is the concentration in gram-ions per liter in the cathode film
δ is the thickness in cm. of the cathode film.

For a given solution R, z, F, and λ are constants, whereas c, T, and δ are variables and may be varied between certain limits. It is seen from equation 1 that the limiting current is increased with increased concentration and temperature and with diminishing thickness of the cathode film.

If, in equation 1, the value of λ is taken to be 50 $ohms^{-1}\ cm^2$, which is valid for many electrolytes in solution of medium concentrations, and taking δ as about 0.05 cm. at a temperature of 20°C., it follows that the limiting current is given approximately as:

$$I_L = 0.025 \cdot z \cdot c \text{ amp./cm.}^2$$

(equation 2)

This equation enables I_L to be calculated approximately for a given deposition process, this process then occurring with 100 per cent current efficiency until the limiting current is exceeded, when another

deposition process begins to compete with the first, the current efficiency of which therefore diminishes.

As a numerical example, we may look at a nickel plating bath with 70 grams nickel per liter. As the nickel ion has a valency of 2 and an atomic weight of 59, the limiting current in this case is obtained by introducing these values in equation 2:

$$I_L = 0.025 \cdot 2 \cdot \frac{70}{59} \cdot 100 = 5.95 \text{ amp./dm.}^2,$$ which

is the limiting current density of nickel in this solution.

Deposition of Smooth, Fine-Grained Coatings

From the above, it is seen that a smooth fine-grained metallic deposit is obtained when a low but constant concentration of the ion to be deposited is maintained in the cathode film, supposing of course that the basis metal is in proper condition, i.e. is free from dirt, grease, and oxides. The factors which are of importance regarding the metal ion concentration in the cathode film are:

1. The current strength.
2. The concentration of the metal to be deposited.
3. The agitation of the solution.
4. The temperature of the solution.

The character of the deposit, therefore, depends upon these conditions, each of which will be treated separately in the following.

THE CURRENT STRENGTH:

It is evident that the higher the current density, the more depleted is the cathode film. This has been experimentally verified by Read and Graham,[8] who found that the copper content in an acid copper plating bath, containing 54 grams copper per liter in the bulk of the solution, diminished with 1.1 grams and 3.1 grams copper per liter in the cathode film, when the current density was 1.1 and 4.3 amp./dm.^{2} respectively. It is also well known that, in plating solutions the pH of which is lower than 7, and in which the cathode current efficiency is less than 100 per cent (i.e. when hydrogen is evolved during the electrolysis), e.g. common nickel plating baths, the pH of the cathode film is considerably higher than in the bulk of the solution, owing to the discharge of hydrogen ions in the film.[9] It may also be mentioned that Brenner and Wranglén[10] found that the nickel content of the cathode film, during electrolysis of a nickel solution of the Watts type, was found to be 8.5 to 9.5 grams per liter below that of the bulk of the solution, corresponding to an average depletion of 15 per cent. These authors also reported that the pH of the cathode film, to a certain degree, is dependent upon the current density, pH being higher with increasing current density until the current density has risen to a value of about 2 amp./dm.^{2}, when pH remains constant, which means that the depletion of the cathode film within certain limits increases with increasing current density.

Ibl and Trümpler[11,12,13] have shown that, in order to get powdery metallic deposits, the limiting current density must be exceeded (which does not mean that the deposition always becomes powdery when the current exceeds this value). These authors point out, however, that it is not the high current density itself that plays a role in this connection, but the important fact is the depletion of the cathode film.

METAL CONCENTRATION:

It is a matter of fact that, for a given current strength, the cathode film is depleted at a faster rate when the concentration of the metal to be deposited is low from the start. By reason of this, the metal content in modern electroplating baths is always high. In this connection it may be pointed out that, according to equation 1 above, the limiting current is proportional to the concentration of the ion to be deposited from the solution. It is obvious that, also from this point of view, the concentration of this ion ought to be as high as possible, in order to electrolyze the solution at a high current density, which is of the utmost importance from an economical point of view.

The movement of ions towards the cathode film can occur in three ways[4]: (a) by diffusion; (b) by convection and; (c) by ionic migration. Of these, the diffusion and ionic migration are treated in this section, as these phenomena are dependent upon the concentration, whereas convection is treated in the next section, dealing with the agitation of the plating bath.

(a) *By diffusion:* As mentioned above, the transportation of ions through diffusion is dependent upon the concentration, the diffusion occuring from the more concentrated to the less concentrated part of the solution, the diffusion rate being higher, the greater the difference in concentration. Because of this, it is advantageous to use a high concentration of the metal to be deposited in plating solutions in order to increase the diffusion velocity across the cathode film.

(c) *By ionic migration:* In electroplating baths used some twenty years ago, e.g. in common nickel plating baths, "neutral salts" such as sodium or ammonium chloride were common ingredients, their task being to increase the conductivity of the solution, as the concentration of the ion to be deposited was rather low. This means, however, that a greater or lesser part of the current is carried by ions, which are not deposited, i.e. the ionic migration of the depositable ion is hampered. For this reason, addition of "neutral salts" is avoided, if possible, in modern electroplating baths.

AGITATION OF THE SOLUTION:

It was stated above that one of the ways for ions to reach the cathode film is by convection, i.e. the movement of ions through streams in the solution. The natural convection, however, in a plating bath through differences in temperature in different parts of the solution, through gas evolution, and so on, is not sufficient to prevent a disadvantageous depletion of the cathode film, the more so as ionic diffusion and migration are not at all sufficient to supply the cathode film with the number of cations necessary for the deposition to occur at a current density satisfactory from an economical and technical point of view. Because of this, electroplating baths are almost always agitated nowadays by means of compressed air, cathode motion, or through pumping the solution, by which means the convection is greatly increased and a sufficient number of ions reach the cathode film per unit of time.

In addition, the ion transportation through diffusion is also increased when stirring the solution, which is

understood from the formula expressing the diffusion rate:

$$\text{Quantity of species transferred per second} = D \frac{dc}{dx}$$

(equation 3)

where D is the diffusion coefficient and $\frac{dc}{dx}$ is the concentration gradient in a film of the thickness dx, dx in this case being the same as the thickness of the cathode film. When dx is diminished, the concentration gradient $\frac{dc}{dx}$ is increased and, hence, the amount of metal ions transported by diffusion across the cathode film. As was cited above, Agar[4] found the thickness of δ to be 0.05 cm. in unstirred and 0.005 cm. or less in stirred solutions. Hence, it is seen from equation 3 that the diffusion rate increases several times when stirring the solution.

Also, from another point of view, it is suitable to stir the plating bath. From equation 2 it is evident that the limiting current increases with decreasing thickness of the cathode film; from the values above of the film thickness in unstirred and stirred solutions, it is found that the limiting current in stirred solutions is at least ten times that in unstirred solutions, which means that deposition may occur at a much faster rate when stirring the bath, without risk of burned deposits.

TEMPERATURE OF THE SOLUTION:

As the diffusion velocity of the ions is increased with rising temperature, it is self-evident that a high temperature counteracts the depletion of the cathode film and, hence, is very desirable when depositing smooth, adherent coatings. It is, therefore, suitable that deposition proceeds at so high a temperature as is practically possible from technical and economical points of view.

Summary

1. The theoretical aspects of obtaining smooth, adherent, fine-grained deposits have been discussed and, especially, the conceptions of the cathode film and the limiting current have been treated in some detail. The importance of low ionic concentration of the metal to be deposited has been emphasized.

2. The practical procedures of getting coatings of good quality have been treated, the following recommendations being the most important:

(a) As high a current strength as possible without depletion of the cathode film which, in general, means the limiting current density.

(b) High concentration of the metal to be deposited.

(c) Agitation of the solution.

(d) High temperature of the solution.

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ACCELERATED TESTING OF METALLIC SURFACES

(*Concluded from page* 51)

test temperature of 120°F. This temperature gives results in little more than one third the time required at 95°F. If the temperature were raised still higher, the test might be reduced to less than 24 hours. A study of this possibility has been scheduled.

The *American Electroplaters Society* has a research project, under the chairmanship of *Walter Pinner*, that is investigating both the acetic acid salt spray and what has been named the "Corrodekote Test." One Corrodekote formula, identified by the number 59,[4] appears to produce significant results in less than 24 hours. Since it also reverses the order of quality as between plated zinc-base die castings and similarly plated steel, as compared with the acetic acid salt spray, there is room for some reconciliation here. It has been demonstrated that the severity of the Corrodekote Test may be increased by the inclusion of salts of iron and copper in the formulation.

In like manner, it has been found that the rate of corrosion development in the acetic acid salt spray may also be speeded up by the addition of either or both iron and copper salts to the spray solution. It is too early yet to draw any conclusions, but the future appears to hold great promise for a workable, significant, and accelerated test for the corrosion resistance of decorative plating on either zinc-base die castings or steel. The acetic acid salt spray is believed to show great promise for all plated metal testing, for variously treated aluminum, and many other items. If those interested will set up the test and make a serious study of it in the light of their specific needs, the industry may soon be in agreement on the details to be specified.

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2. Rubber lined boxes with acrylic or hard rubber parts may be satisfactory. Such are available commercially, but require minor modification.
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Kaolin	30	g.
Ammonium Chloride	1	"
Copper Nitrate	0.035	"
Ferric Chloride	0.165	"
Water	50	ml.

Cleaning Metals and Alloys

• By C. B. F. Young, *President, Apley N. Austin Co., Pequabuck, Conn.*

This is the second half of Dr. Young's article. The first part appeared in our October issue.—Ed.

Alkaline Cleaners

The fundamental requisites of an efficient cleaning bath are as follows:

1. Readily wet surface to be cleaned.
2. Readily penetrate between basis metal and dirt to be removed.
3. Readily remove oils and dirt, and emulsify and hold them in suspension.
4. Be well buffered at the required pH for the life of the bath.
5. Be stable in hard water and not leave calcium and magnesium residues on work being cleaned.
6. Not attack or cause the work to tarnish to any extent.
7. Rinse freely and leave no residue when rinsed in cold water and subsequent acid dip.

All of these requirements are not always accomplished in practice; however, if the first four are met, good cleaning can be obtained in most cases.

As wetting and penetrating are in proportion to the surface and interfacial tension it is important that these factors be made as low as possible. For good results, the surface tension should be about 25 to 30 dynes and the interfacial tension about 10 to 12 dynes. When surface tension is mentioned, one is speaking of the attraction between molecules at the surface of the liquid where an unbalanced condition exists. The molecules at the surface are pulled inward by the other molecules in the interior of the liquid while no such pull exists in the air phase, and the surface acts as if it were under tension, which is actually true. This tension is usually measured as the force in dynes required to extend a surface one centimeter in length one square centimeter. Surface tension is the measurement of a liquid-air interface; interfacial tension is a similar measurement but made between a liquid-liquid interface. In addition to promoting wetting and penetrating, a low surface and interfacial tension makes for good emulsification. Keep in mind that the two solutions are insoluble in each other. In practice, these low surface and interfacial tensions are obtained through the use of soaps or surface-active agents, popularly known as wetting agents.

It is very important that the proper pH be maintained for the life of the bath. The pH value of a cleaner will be determined also by the metal being cleaned. Sometimes a compromise has to be reached. For example, oils and greases are more easily removed above a pH of 12, but zinc dissolves above a pH of 11. Under these circumstances, therefore, a lower pH has to be maintained so that the metal will not be attacked. The maintaining of the optimum pH is termed its buffering capacity, and this is usually measured in terms of standard acid in cc's required to lower the pH of the cleaning solution one pH unit. In practice, the optimum pH is automatically regulated by using salts of weak acids and strong bases in conjunction with sodium hydroxide and sodium carbonate.

As the calcium and magnesium in the water supply react with the various components of the chemicals used in making cleaning baths, it is desirable, wherever possible, to incorporate in the cleaning formula materials such as complex salts which will unite with or sequester the offending elements. In practice this is inefficiently obtained by using complex phosphates; inefficiently because, under the conditions of use, namely at temperatures above 180°F. and in the presence of fairly large percentages of sodium hydroxide, these complex phosphates break down, reverting to orthophosphate which, in the presence of sodium hydroxide, becomes trisodium phosphate, which does not do the job expected. Wetting agents generally used also help to sequester the calcium and magnesium ions. There are now available compounds which render these ions soluble in water. These materials are known as chelating agents, which comes from chelation and means complexing. There are a number of compounds manufactured but one group is the sodium salts of ethylene diamine tetraacetic acid and other polyamino acids. These products are stable at high temperatures and regardless of the pH range.

Equally important with cleaning efficiency is the ease with which the cleaning material is removed from the work. A properly balanced cleaner will rinse rapidly and freely. This is usually obtained in practice by incorporating trisodium phosphate and the proper wetting agent in the cleaning bath. One of the advantages in using wetting agents rather than soap is the fact that they are stable in acids as well as alkali and will not break down to form fatty films on the work, as do ordinary soaps.

The essential raw materials generally used in formulating a cleaning solution are sodium hydroxide, the various silicates ranging from orthosilicate (the most highly alkaline) through metasilicate (of medium alkalinity) down through the water-glass type or trisilicates (of high silica content and low alkalinity), the last mentioned generally being used as an inhibitor in aluminum cleaning compounds; trisodium phosphate, sodium carbonate, and soaps (low titre), sulphonated oil or wetting agents.

The sodium hydroxide supplies the active and re-

serve alkalinity and, in conjunction with the silicates, phosphates, and carbonates, forms buffer mixtures.

The silicates are used as buffer salts for the protection they give to sensitive metals and for their colloidal properties which help stabilize the solid dirt particles. They are also used for their mechanical scouring action.

The trisodium phosphate is used for its ability to aid the alkalis to rinse freely and for its good cleaning, peptizing, and buffering effects.

The soda ash is used as a source of alkalinity and as a buffering material when used in conjunction with sodium hydroxide.

Wetting Agents

The soaps, wetting agents, and sulphonated oils are used for lowering surface and interfacial tensions, stabilizing emulsions and peptizing the dirt.

Because soaps are not stable in the presence of calcium and magnesium, as in acid solutions, and because the sulphonated oils are not too good as detergents, more and more interest is being taken in the newer type of compounds generally referred to as surface active or wetting agents. These materials, unlike soap, will not break down in the presence of calcium or magnesium ions, or in acid. For these reasons and others mentioned above, they are very useful in cleaning baths. Broadly speaking, the surface-active materials have molecules consisting of a long chain hydrocarbon portion known as a nonpolar group, soluble in an oil phase, to which is attached a water-attracting or polar group. There are a large number of groups which function this way. For maximum effectiveness a proper balance must exist between the nonpolar and the polar group. Surface-active agents function by promoting a reduction of the surface and interfacial tension between an aqueous solution and a hydrocarbon phase with which it is in contact. The molecules of the wetting agent orient themselves in such a way that the polar groups are attracted to the aqueous phase while the hydrocarbon chain is adsorbed at the non-aqueous phase.

Wetting agents generally used fall into three classes. Firstly, there are so called anion-active which means that, on ionization, the larger portion of the molecule becomes negatively charged. This type is represented by the sulphated alcohols. A good example are the aryl alkyl sulphonates.

The anionic group is the oldest and best known. This group is active because of the oil-soluble anion or acid radical. Goldsmith has summarized this as follows: "To this group of materials belong, among many others, the alkali soaps, the soaps of water-soluble amines, the sulfonated oils (such as Turkey Red oil), the sulfonated fatty alcohols, and the fatty alcohol sulfates, the sulforaphthenates and petroleum sulfonates, the aromatic sulfonates (such as the sulfonated alkylnaphthalenes), the sulfosuccinic acid esters, the arylalkyl sulfonates (such as the Twitchell reagents), the sulfonated amides, sulfonated phenols, as well as many other sulfated, phosphated, or borated compounds."

The cationic group, of fairly recent origin, is the reverse of the anionic group. Its surface activity is due to the presence of a long-chain, oil soluble cation and, consequently, the cationic surface-active agents are inactivated or precipitated by anionic agents such as soap. Among the numerous materials belonging to this second group are the salts of long-chain aliphatic amines, certain half-amines of diamines (such as the "sapamines"), long-chain guanidines, long-chain quaternary ammonium salts (such as the alkyl pyridinium salts), and certain hydroxyalkyl amine esters (such as esters of triethanolamine).

The third group, the non-ionic surface-active agents, is exemplified by a number of widely used and well-known chemicals. These have, however, received less recognition as a clearly defined group of surface-active agents than the other two types. Non-ionic surface-active agents, as their name implies, are not ionizable and owe their effectiveness to a proper balance between certain hydrophilic (polar) and lyophilic (non-polar) groups in their molecules. The hydrophilic character is usually obtained by the presence of a certain minimum of accumulated polar groups, such as free hydroxyl or ether-oxygen groups.

Non-Ionic Surface-Active Agents

In accordance with this observation, the majority of compounds suggested and used as non-ionic surface active agents are from the following categories:

1. Partial esters of polyhydric alcohols with long-chain carboxylic acids.
2. Partial and complete esters of certain water-soluble hydroxyalkyl ethers of polyhydric alcohols with long-chain carboxylic acids.
3. Ethers of polyhydric alcohols with long-chain fatty alcohols.
4. Short-chain hydroxyalkyl ethers of polyhydric alcohols esterified with long-chain fatty alcohols.
5. Long-chain alcohols with a number of free hydroxyl groups.
6. Esters of long-chain alcohols with polyhydroxy acids.
7. Long-chain acetals of polyhydric alcohols.
8. Condensation products of fatty acids with protein decomposition products.
9. Amides prepared from long-chain amines and polyhydroxy acids.

Among these groups, the first two are probably the most easily accessible, and many chemicals of these classes are already on the market under chemical or trade names. Drawing from these two groups alone, considerable variety is possible. From the study of the esters of polyhydric alcohols and of polyhydric alcohol esters, this type of non-ionic surface-active agent offers many advantages. The stability of non-ionic surface-active agents with regard to hard water, earth alkali, or heavy metal salt solutions, is usually far greater than that of cationic or anionic agents of a similar degree of water solubility. Some of them are unaffected or only little affected by limited contact with strong acids or alkalis. They are neutral, but may be adjusted to give an alkaline or acidic reaction without necessarily losing their usefulness. They may be used in conjunction with either the cationic or anionic surface-active agents, and such combinations usually have greater effectiveness than either of the ingredients alone. For

instance, blends of polyhydric alcohol esters with soaps are well-known as effective emulsifiers.

The non-ionic surface-active agents are superior to the anionic and cationic agents in range of compatibility with solvents and chemicals. Their effectiveness may be further improved by the addition of certain solvents such as alcohols, glycols, or glycol-ethers, terpene alcohols or fatty acids. Their adsorption by wool and possibly by other fibers is less than that of anionic or cationic compounds. They usually will not react with weak organic acids or bases, such as certain dyes or pharmaceuticals. A complete discussion of this subject was presented by Young & Coons.[4]

One of the newest developments in the cleaning of metals is the use of solvents that emulsify in water. The action of this class of materials is to rapidly wet out the dirt and physically dissolve grease, oil, or any other material soluble in it. On subsequent rinsing, everything is washed away, leaving a thin film of solvent which can readily be removed in mild alkali. As these solvents emulsifying types do not clean by chemical action, they are safe to use on any metal. They will remove combinations of dirt that ordinarily cannot be efficiently removed either in a degreaser or alkaline cleaner.

One other method of cleaning should be discussed at this point. Electrocleaning which, although known for many years, has not been generally used until the last two to three decades.

Electrocleaning is usually used as a final cleaner prior to electroplating. The work to be cleaned is made either the cathode or anode depending upon the metal. While metals such as zinc, lead, etc. and brass are usually cleaned as a cathode, steel more often is cleaned as anode. However, both cathodic and anodic cleaning of all metals is being practiced. It is usual to first clean as cathode and then reverse the current for a few seconds. By this method any metal which has been deposited as an impurity will be redissolved during the anodic period. Electrocleaning is done at various current densities depending on the metal and method of cleaning.

In Table II are given several cleaning formulas and their operating conditions. It may be a matter of interest to note the ratio of active to inactive alkali and the pH of various raw materials used in making cleaning solutions.

The last three are usually used as water softeners. Tetrasodium pyrophosphate is the only one stable above 140°F. The others revert to orthophosphate at high temperatures.

Typical Cleaning Processes

FERROUS METALS:

1. *Chlorinated solvent degreasing*
2. *Emulsifying solvent*

Triethanolamine tallate	15%
Butyl carbitol	10%
Cresylic acid	10%
Kerosene or mineral spirits	65%

Use at room temperature. Soak or spray work. Rinse off with spray rinse. (NOTE: As this type of material works by physical action only it can be used on any metal.)

3. *Soak alkali cleaner.*

Caustic soda	40%
Sodium metasilicate	20%
Sodium carbonate	20%
Trisodium phosphate	15%
Sodium tallate	5%

Concentration: 4 to 6 oz./gal.
Temperature: 180-212°F.

Follow with hot or cold water rinse. Can be used as an electrocleaner with either direct or reverse current. (Not as efficient in this respect as the formula given below for final cleaning.)

Voltage: 6 Current density: 40 to 50 amp./sq. ft.

This cleaner can, in the majority of cases, be used as a final cleaner.

4. *Final cleaning before plating.*

Caustic soda	75%
Trisodium phosphate	10%
Sodium carbonate	14%
Wetting agent	1%

Concentration: 10 to 16 oz./gal.
Temperature: 180° to 210°F.
Voltage: 6
Current Density: 75 to 100 amp./sq. ft. anodic

COPPER AND COPPER ALLOYS:

1. *Chlorinated solvent degreasing.*
2. *Soap soak.*

Any soap may be used such as whale oil (deodor-

TABLE II

Basic Material	*Active Alkali to phenolphthalein %Na₂O*	*Inactive Alkali to to methyl orange %Na₂O*	*Total Alkali*	*pH of 1% Sol. at 20°C.*
Caustic soda	76.00	....	76	12.2
Sodium sesquisilicate	35.31	1.72	37.03	11.8
Sodium metasilicate	27.99	1.38	29.37	11.5
Trisodium phosphate	10.06	8.37	18.43	11.2
Sodium carbonate	29.00	29.00	58.00	10.9
Sodium sesquicarbonate	15.42	25.85	41.27	9.8
Borax	16.14	4.81	20.95	8.9
Sodium bicarbonate	2.28	34.91	37.19	7.8
Sodium hexametaphosphate	None	2.95	2.95	6.9
Sodium tetraphosphate	.83	38.77	39.60	8.5
Tetrasodium pyrophosphate	6.70	16.21	22.91	10.5

ized), sodium oleate, sodium tallate. Use 2 oz./gal., 150°F. with agitation.

3. *Soak Alkaline Cleaner.*
   Sodium metasilicate 90%
   Any of above mentioned soaps 10%
   160° to 180°F. with agitation
4. *Final cleaning before plating.*
   Caustic soda 10%
   Trisodium phosphate 45%
   Sodium carbonate 44%
   Wetting agent 1%
   Concentration: 3-4 oz./gal.
   Voltage: 6
   Current density: 30-40 amp./sq. ft.
   Temperature: 160° to 180°F.

If used as an electro cleaner use direct current, then reverse for about 15 to 30 seconds. Follow with cold water rinse.

WHITE METALS (zinc, lead, tin, etc.):

1. *Chlorinated solvent degreasing.*
2. *Soak alkaline cleaner.*
   Sodium metasilicate 97%
   Wetting agent 3%
   Concentration: 3-4 oz./gal.
   Temperature: 160° to 180°F.
   Use agitation and follow with cold water rinse.
3. *Final cleaning before plating.*
   Trisodium phosphate 50%
   Sodium carbonate 49%
   Wetting agent 1%
   Concentration: 2-4 oz./gal.
   Temperature: 160-180°F.

If used as an electrocleaner use 6 volts direct current, at current density of 30 to 40 amp./sq. ft. A 10 second final reverse cleaning can also be used.

Simplifying the Cleaning Process

The above represents a sound logical scientific approach to metal cleaning. In spite of changing the variables the plater will run into trouble from metal cleaning. Why? There are several reasons for this. The materials to be removed are mainly refuse from the buffing operation. This refuse is insoluble in water. As has been pointed out above, buffing and polishing compounds are composed of I, Abrasives; II, Vehicles; III, Cellulose; IV, Mixtures of I, II, and III. It should be pointed out that the abrasive used varies little. The same is true of the cloth or cellulose. However, the vehicles can and are varied. As has been pointed out, stearic acid is an organic acid which can be saponified, i.e., it will unite with sodium hydroxide forming thereby ordinary soap. This is soluble in water. If the price of stearic acid increases, some will substitute petrolatum or other straight chain hydrocarbons which cost about a third as much, but which are not saponifiable and, therefore, are harder to clean. The results can be disastrous for the plating department. Thus, buffing compounds which cleaned before, now fail to come off the work. The plater is blamed for it. No wonder some platers have such a rough job. In Table III is shown the high and low price of stearic acid over the years[5] Note the variations in price.

TABLE III

Year	Low	High
1945	15⅞¢/lb.	15⅞¢/lb.
1946	15⅞	33½
1947	23	38
1948	24	37
1949	13½	20
1950	13¾	23
1951	11¾	26¼
1952	11	12½
1953	11	12¾
1954	11¾	14¼
1955	14¼	15¼

As one can see there is a tendency to substitute cheaper materials for the more expensive stearic acid as the price of the latter increases. Another place where the price of buffing compounds can be decreased is to add remelt stock to the virgin material. Many times the butts of the bar or the unused portion of the bar are sent back to the manufacturer for remelting. Along with them comes the accumulation of dirt inherent in such an operation. At the same time, foreign bars get mixed in due to mistakes, etc. Thus, an aluminum oxide bar might get into the silicate type. Thus, scratches will be obtained on the work after the remelt. For this reason some customers demand virgin material throughout, which in many cases is very wise.

It has been pointed out above that the abrasive, the wheel, and the metal being polished, cannot be varied to any large extent. Furthermore, all are insoluble in water. The question then arises: Is it possible to improve the buffing operation so that the dirt remaining after polishing can be removed more easily? The most promising method appears to be to render the binder soluble or dispersible in water? The vehicle then completely surrounds the abrasive and aids in floating off these particles. It was found that, by producing complex polyol esters of stearic acid with the proper balance between the hydrophobic and the hydrophilic group, a chemical compound could be produced which had the mechanical properties of stearic acid in relalation to the carrying power of the abrasive to the wheel and to the work.[6] At the same time, these materials were dispersable in water. Buffing compounds have been perfected which are water dispersible and yet give a good cut and produce good mileage. These materials are a definite improvement over the old type bars, but are not the answer to all the cleaning problems. Trouble is still encountered when the dirt is packed into corners or crevices and the aqueous solution has trouble penetrating under the whole. More research is now being carried out to overcome this handicap.

Another interesting feature of these buffing compounds is that they rinse off quickly from the hands of the workmen. A polisher needs only to go to the cold water faucet and massage his hands under the spigot. Of course, hot water will work faster but is not essential. The results are excellent due to the fact that the binder used in the dispersable compounds are water soluble and rinse off instantly. Workmen are well pleased with this property as the clean up time is reduced to a minimum.

(*Concluded on page* 65)

Trailer-Borne Instruments Save Manpower In Checking Plant Waste Effluents

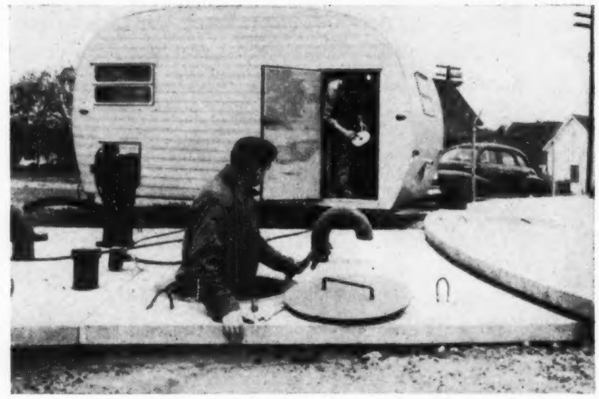


Fig. 1. Charlotte's trailer is parked near waste outlet from an industrial plant where 24-hour test of pH and flow rate is to be conducted.

AUTOMATIC recorders in specially designed trailers rove from plant to plant in the City of Charlotte, N. C., keeping a watchful eye on industrial wastes being discharged into sewer mains. The city's Water Department has two such trailers equipped to make 24-hour tests of plant effluents by continuous measurement of pH (acidity or alkalinity), flow rate, and total volume of flow.

City regulations require that each plant discharging over 40,000 gallons a day have its effluent checked every 90 days. In addition, regardless of quantities involved, any corrosive mixtures detected at disposal plants have to be traced to their source and responsible plants notified. This test work has to be done for over 60 manufacturing plants with some 500 miles of sewer lines spread over an area of about 45 square miles.

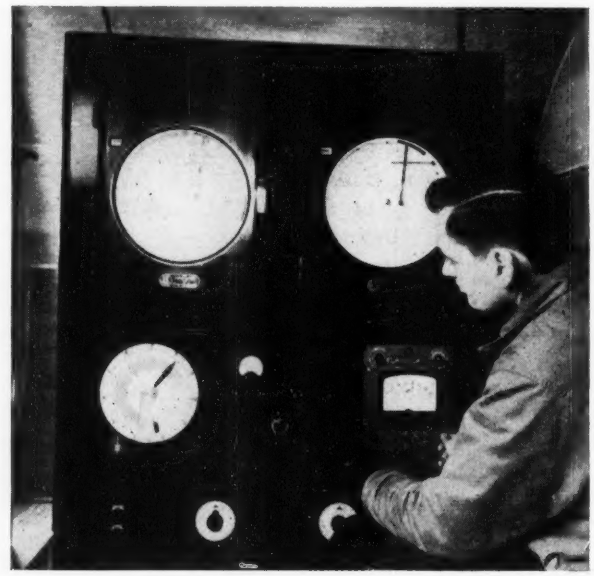
Excessive acidity or alkalinity in large volume discharges creates severe problems. It will badly corrode sewer mains, adding greatly to maintenance costs. Overtaxed treatment facilities can result in dangerous pollution of fishing and bathing facilities. Sludge from treated sewage, sold for soil enrichment, can be spoiled.

By former manual sampling and checking methods, the city's Industrial Waste engineers faced a burdensome and time consuming task. Furthermore, continued industrialization in the Charlotte area promised to intensify the work. The mobile trailers with automatic recorders were adopted to speed the checking job with a minimum of manpower.

Use of automatic recorders in the trailers permits the 24-hour test to be conducted without the need for constant supervision. Once the proper instrument connections are made for measurements at the plant effluent line, the pen of the recorder continuously plots the pH value of the waste on its paper chart. At the same time, one of the two flow meters charts the rate of flow — one meter being used for lower flow rates and the other for higher flow rates. An integrating device on each flow meter shows the total volume of flow for the test period.

Time markings on the charts tie in accurately recorded values with the exact time of day. Charlotte's engineers, therefore, can verify that conditions of plant effluent have remained within permissible limits throughout the 24-hour test period. (The pH must re-

(*Concluded on page* 64)



Panelboard inside the trailer contains low and high range flow recorders (top) and pH recorder at bottom left. Instrument at bottom right is pH indicator which measures pH and sends electrical measuring signal to the recorder.

Fig. 3. Rugged pH electrode assembly has extension cable to permit insertion in plant effluent line. This measuring element includes a temperature compensator to assure accurate pH measurement.

Surface Treatment and Finishing of Light Metals

Part XII-A. Plating on Aluminum — Chemical Etching Processes

By S. Wernick, Ph.D., M.Sc., F.R.I.C., F.I.M. and R. Pinner, B.Sc.

THE decoration and protection of aluminum and its alloys by the application of electrodeposits result in a very attractive combination of valuable properties of the basis metal with highly desirable surface attributes, and on this account a great deal of interest has been taken in the development of efficient means of plating aluminum. Chromium plated aluminum of good quality, for example, possesses the following formidable array of attractive properties: strength; ease of fabrication; lightness; attractive finish; relative economy.

The low specific gravity of aluminum, whereby approximately three times as many components may be produced from the same weight of material compared with ferrous or other common base metals, is an important economic factor which makes it well worth while investigating the possibility of replacing heavier metals of construction by the light alloys. Thus, the possibility of substituting zinc-base die-castings by aluminum castings may frequently repay close examination.

Such substitution is not, however, clear cut as, unfortunately, some aluminum alloys do not lend themselves so readily to finishing by electrodeposition, and a careful study needs to be made where substitution of the base metal is sought in a manufacturing sequence. Partly for this reason and partly because the corrosion resistance of electroplated aluminum is not as good as that of heavy metals in outdoor conditions, the commercial plating of aluminum has not proceeded as rapidly as might have been expected. Nevertheless, the production of electroplated aluminum products is steadily increasing, albeit in certain well-defined fields rather than in any general manner. Thus, plated aluminum household articles such as tea and coffee sets have been produced for well over a quarter of a century, whereas plated aluminum components for motor cars, where at first sight the advantages of using light alloy would seem most striking, are rarely to be encountered.

The position of aluminum in the electrochemical series, together with its high affinity for oxygen, are the fundamental factors which have entered into the problem of plating this metal. It is the oxide film which is present on the surface of aluminum-base materials, the persistence of which militates against adequate adhesion of the deposit. The oxide film may be as thick as 10^{-7} mm. Should it be removed, exposing the bare metal to the atmosphere, it is succeeded by a fresh film. Hence preparatory treatment of aluminum is based largely on one of two techniques: either the oxide film is completely removed before deposition or, alternatively, it may be artificially thickened by methods of anodic oxidation which produce a coating of well-defined porosity in which a subsequent metallic layer can be anchored. The mechanism for the latter process, which at first sight seems contradictory to what has been indicated previously, will be explained in a relevant section at a later stage.

Metals Deposited on Aluminum

While nickel and chromium are the metals most commonly deposited on aluminum, there are special applications making it desirable to apply other metal deposits. It must be remembered that aluminum is anodic to most of the metals commonly deposited on it and hence it is essential that the deposited metal should be largely pore-free if adequate protection is to be achieved.

Various metals have been applied to aluminum to provide a solderable surface. These include, copper, tin, zinc and silver, in addition to nickel, while brass has been deposited for the bonding of rubber to aluminum surfaces. For electrical purposes, silver is occasionally deposited, as are also some of the precious metals, for example, gold and rhodium for electronic equipment. The coating of engine pistons with tin and chromium has been undertaken to achieve higher resistance to wear.

Difficulties Connected with the Plating of Aluminum

Apart from the difficulty arising through the high affinity of aluminum for oxygen, the following factors must be considered and bear upon the problem in general:

(1) The amphoteric nature of the oxide which complicates the possible reactions likely to occur either during or subsequent to preparing the surface for plating.

(2) The position of aluminum in the electrochemical series which leads to the ready formation of immersion deposits in plating solutions, obviously affecting adhesion of the plating.

(3) The co-efficient of expansion of aluminum and its alloys, differing markedly from that of most of the metals commonly deposited on it. According to E. G.

TABLE I

Mean Coefficient of Expansion of the Common Metals

Metal	$\times 10^{-6}$
Chromium	7
Steel	11
Nickel	13
Gold	14
Brass	18
Copper	18
Silver	19
Aluminum	24
Tin	27
Zinc	27
Cadmium	31

West,[1] in applications in which considerable temperature changes occur, the differential expansion of aluminum and the metal coating may cause sufficient strain to rupture the bond between the deposit and the basis metal (see Table 1).

The same author lists the electrolytic potentials of the common metals against pure aluminum (Table 2).

Classification of Methods for Plating Aluminum

Many methods have been proposed for producing deposits on aluminum, but they may be broadly classified as follows:

(1) Mechanical preparation;
(2) Chemical procedures;
(3) Anodic processes;
(4) The Vogt process;
(5) Processes based on the zincate technique.

Of these, the first two processes are those normally used today for hard chromium plating of aluminum, while the last three are mainly used for decorative applications.

It will be noted that the Vogt process has been given a classification to itself. This special treatment is deliberate because both the method and its commercial application come into a unique category. The reason for this is the very wide application of the process, particularly as practiced in the United Kingdom.

TABLE 2

Electrolytic Potentials Against Pure Aluminum

Metal	*Potential (mV)*
Magnesium	— 850
Zinc	— 350
Cadmium	— 20-0
Pure aluminum	0
Al-magnesium alloys (BS.L46, D.T.D. 182A)	+ 100
Duralumin-type alloys (BS.5L3, 6L1, etc.)	+ 150
Iron and mild steel	+ 50-150
Tin	+ 300
Brass	+ 500
Nickel	+ 500
Copper	+ 550
Silver	+ 700
Stainless Steel	+ 400-700
Gold	+ 950

Processes Based on Mechanical Treatments

As early as 1930, H. C. Cocks[2] described methods of producing a rough surface, e.g., by sand blasting, with the object of achieving an efficient application of electrodeposited zinc to produce high corrosion resistance. In 1933, H. K. Work[3] pointed out that mechanical techniques of this type did not in effect produce satisfactory commercial results, due largely to the open nature of the pits produced thereby. The latter author accordingly developed a specific etching treatment for each type of alloy producing pits of an undercut type in order to provide a mechanical key for the subsequent deposit.

According to another process[23] developed for use in hard chromium plating, fine quartz flour is used in a water blast. By this means the oxide film is destroyed mechanically and the adherent wet film protects the aluminum from further oxidation before plating. The film is removed only by hydrogen evolution in the chromium plating solution itself and this fact, combined with the good mechanical key, is stated to account for the good adhesion obtained. Meyer-Rassler, however, was not able to reproduce the good results claimed for this process.[22]

B. K. Braund and H. Sutton[4] in 1936 pointed out that sand blasting was objectionable as a means for producing roughened surfaces, for the following reasons:

(1) The roughness of the surface persists through the deposit;
(2) The treatment of large surfaces is expensive;
(3) Thin sheet material is liable to buckle;
(4) There is a health hazard in sand blasting.

Chemical Etching Processes

Various attempts have been made to base preparatory processes on the application of chemical etches with and without the subsequent deposition of a thin coating of metal by immersion in solutions of corresponding metallic salts. Thus, such chemical etches as caustic soda; caustic soda plus sodium chloride, hydrochloric acid, hydrofluoric acid, hydrofluoric acid plus hydrochloric acid, and hydrofluoric acid plus nitric acid.

One of the first such techniques was that of H. W. Work,[3] who used acid mixtures primarily to roughen the surface of the aluminum or alloy with a view to securing adhesion by mechanical keying of the deposit to the surface. The following is typical of these solutions:

Nitric acid (s.g. 1.42)	3 vol.
Hydrofluoric acid (50%)	1 vol.
Temperature	20 to 30°C.

Time of immersion for castings:

Pressure die castings	15 to 30 sec.
Gravity die castings	30 to 90 sec.
Sand castings	60 to 120 sec.

It will be noted that these conditions are somewhat

critical, and since formation of even a slight oxide film during the time elapsing between immersion in the acid solution and plating proper may well result in poor adhesion, the technique has obvious disadvantages.

It is interesting to note that Work recommended the use of metal salts in the acid dips for some purposes; for example, prior to nickel plating, acid dips might contain a nickel, iron or manganese salt, the appropriate metal being deposited on the aluminum by chemical replacement to form what was hoped to be a satisfactory preparation for the deposition of nickel. Work, in preparing aluminum-alloy die castings for nickel plating, used the nitric acid-hydrofluoric acid dip to dissolve the eutectic but allowed the solid solution to remain unattacked. The method at least effectively produced a roughened surface for keying purposes.

More recently, J. M. Bryan[5] has departed from the conventional types of chemical etchants described above by advocating a solution based on trichloracetic acid. He tried out numerous combinations of acid and alkaline etching solutions with a view to producing an etch which would not only be satisfactory from a technical viewpoint but also would satisfy the following commercial considerations:

(1) Low cost of chemicals;
(2) Safety in application to the operator;
(3) Reasonably long life of solution;
(4) Reasonably short time of etching;
(5) Uniformity of etching;
(6) Minimum attack on underlying metal, compatible with efficient removal of the film.

He concluded that those solutions containing acid in combination with the chloride ion were the most effective in dissolving the surface film. This was attributed to the great power of penetration of chloride ions which were able to pass through the oxide film some 25 times as rapidly as sulphate ions. Secondary film formation, which lowers the efficiency of etching and renders the time of etch critical, was found to be inappreciable with the chloride type of etch; on the other hand, it was quite noticeable with alkaline solutions and those containing nitric acid.

The combinations included sulphuric acid plus hydrochloric acid, acetic acid plus sodium chloride, hydrochloric acid plus sodium chloride, hydrochloric acid plus aluminum chloride, and trichloracetic acid. Of the various acid-chloride etchants used, trichloracetic acid was found to fulfill the above requirements to the best advantage. Etching with this acid was found to take only a matter of a minute or two, leaving a very smooth surface free from pits. It could be used in high concentration, which was an additional advantage in that it added greatly to its service life, while low water content possibly helps to restrict secondary film formation.

One of the difficulties encountered was the precipitation of aluminum hydroxide or basic salts of aluminum. Bryan, however, found that this action could be considerably delayed by the addition of an hydroxyorganic substance which could combine with the aluminum to form a suitable complex salt. Sucrose could be used for this purpose but it was apt to char. Lactic acid was also suitable to prolong the time of etching. Glycol and glycerin were found to render the etchant too vigorous in its action.

Dextrine had none of these drawbacks and the best etching solution was accordingly based on the following formula:

Dextrine	50 g.
Water	150 cc.

Trichloracetic acid (melted crystals) to 1 liter.

The solution was used at 95°C., the time of etching being 1 to 2 minutes. The activity of the solution was found to increase with use and shorter etching times could then be employed.

The average loss of weight of aluminum (99.3 per cent) incurred through etching was found to be 0.14 g./sq. dm. (1.3 g./sq. ft.) of surface area; this is equivalent to a reduction in surface dimensions of 0.0002 in.

The technique is, however, not free from a number of disadvantages, which are listed by the author as follows:

(1) The solution being viscous, the loss through drag-out is likely to be appreciable.
(2) There are objectionable fumes at 95°C.
(3) The hot solution is apt to affect the skin of the operator and rubber gloves are therefore essential.
(4) The cost of the solution is somewhat high.

Actually, of course, there are other quite serious disadvantages; for example, acetone is advocated for rinsing purposes which would not be very practicable under normal commercial conditions. Apparently, also, even a brief wash in water after etching would lower the adhesion of nickel deposits.

Quite early in the development of etches for the preparation of aluminum for plating it was found that better results were often obtained by the inclusion of a heavy metal salt (usually iron, copper, nickel or manganese) in the etch to give an immersion deposit of the metal. Although this is a point of similarity between these processes and the zincate processes, the two are best discussed separately. As regards their application, while the present processes form the basis of methods used in hard chromium plating, the zincate process, which generally leaves a smoother surface, is more often used in decorative plating.

Etches Containing Heavy Metals

One of the earliest advocates for the application of an undercoating of iron as an immersion deposit was M. Ballay, who in 1930[6] employed a hot ferric chloride bath containing free hydrochloric acid, the concentration of iron varying from 6 to 22 g./l. and of free HCl from 0.1N to 0.7N according to the material (type of alloy) to be treated.

B. K. Braund and H. Sutton,[4] who tried this method in 1936 using a solution containing 15 g./l of iron and 0.5N HCl, found that adherent deposits (of zinc) free from blisters were obtained on aluminum, but on duralumin small blisters formed. Immersion in the ferric chloride bath produced in both cases an adherent dark-grey deposit comprising a thin film of iron which could not readily be detached by mechanical means. These authors mention, incidentally, that an attempt to make use of a second method for preparing aluminum

as used by Ballay, based on the use of an electrolytic process, the electrolyte being 10 per cent sodium carbonate solution, proved to be entirely unsatisfactory.

Braund and Sutton also found that it was essential for the components on which iron had been deposited by immersion not to be allowed to dry before being transferred to the subsequent plating bath.

H. K. Work[3] recommended the deposition of nickel by immersion in the treatment of commercially pure aluminum but preferred manganese as the deposited metal in the treatment of sheet and wrought alloys; the respective baths for depositing these two metals were as follows:

(a) *Treatment of commercially pure aluminum:*

Nickel chloride ($NiCl_2 \cdot 6H_2O$)	56 oz.
Hydrochloric acid (sp. gr. 1.18)	2 pints
Water	1 gallon
Temperature	37°C.
Time of immersion	15 to 30 sec.

(b) *Treatment of sheet and wrought alloys:*

Hydrochloric acid (sp. gr. 1.18)	3 pints
Water	6 pints
Manganous sulphate ($MnSO_4 \cdot 2H_2O$)	½ oz.
Temperature	37°C.
Time of immersion	15 to 30 sec.

In 1937, Finkh[7] patented a hot, acidified ferrous chloride solution which was advocated for the production of a suitable deposit of iron prior to electrodeposition proper.

In all the above instances the objective was to produce a thin film of metal to act as a satisfactory basis on which to electrodeposit the desired metal. Other techniques have, however, been developed with the object of using the immersion deposits in transitory form, the latter being removed by dissolution in the plating bath with simultaneous electrodeposition of the required deposit. Early German technique, in particular, seemed to favor methods based on such procedure. Thus, as early as 1932 a method, whereby zinc deposited from a zincate solution was removed in a subsequent nitric acid bath, was advocated prior to chromium plating. In 1941, Gebauer[8] proposed the production of a very thin deposit of copper which could then be built up with nickel or chromium, using a similar procedure initially. The process is said to be particularly useful in the treatment of aluminum alloys containing magnesium or zinc.

A. Beewald[9] described the "D.V.L." process which made use of varying etching solutions according to the alloy to be treated. The following are examples:

(a) *Alloys containing copper and magnesium:*

First etch: hot 10 per cent caustic soda solution.
Second etch: Nickel chloride solution saturated.
Hydrochloric acid 2 per cent.
Boric acid 4 per cent.

(b) *Aluminum magnesium alloys:*

Cupric chloride 15 per cent.
Hydrochloric acid 0.5 per cent.

In each of the above cases the technique consists in the immersion deposit being removed by treatment with nitric acid and then immediately depositing the metal to be plated subsequently (in particular, chromium).

It will be seen from the above that the number of methods based on chemical etching is not inconsiderable and, indeed, it would be possible to employ permutations and combinations of such methods in the case of any particular alloy as a trial procedure with probably some hope of achieving satisfactory results in many instances. It cannot, however, be said that any single method based on such technique has been proved to be outstandingly successful thus far.

(References will appear next month)

TRAILER BORNE INSTRUMENTS

(Concluded from page 60)

Typical chart record shows variation in pH throughout the 24-hour test period.

main within the range of 6 to 9 — 7 being a natural value).

With the information provided by the recorders, the city's engineers can check at a glance whether or not the plant waste is near enough to being harmless. In all cases, they take a sample for laboratory analysis which becomes a matter of routine or high priority, depending upon the story the recorder tells. Plants that discharge over 40,000 gallons of waste a day are required to install holding tanks from which the waste can be released at acceptable rates into the city's mains. In addition, if the waste is dangerously acid or alkaline, the plant must treat the waste to bring it within the prescribed pH range, before discharging it into the sewer.

Photos courtesy Leeds & Northrup Co.

Finishing Pointers

High Chloride Nickel Bath

By J. B. Mohler

THE characteristics of a nickel bath can be appreciably changed by changing the composition of the bath. Consequently, there are a great many different formulas in use for special purposes. Different baths are used for plating bright, dull, soft, and hard nickel. Also, specific bath formulas have been developed for plating at room temperature, and for thin and heavy deposits. Nickel baths are used for striking and activation. Special baths are used for barrel plating and for particular applications, such as electrotyping.

A nickel bath can be formulated to favor high conductivity and good anode corrosion. Nickel chloride and hydrochloric acid are both useful when these factors are of primary importance. Such a bath is made up with 60 oz./gal. of nickel chloride and 1.3 oz./gal. of hydrochloric acid. The following limits will apply:

Nickel	13-15 oz./gal.
HCl	0.7-1.3 "
Temp.	170-180°F.
Current density	40-60 amp./ft.^{2}
Cathode efficiency	80-90%

This bath is useful for plating for engineering purposes or for plating of heavy industrial deposits. The deposit is smooth and grey and there is little trouble with pitting. If pitting is encountered it can be corrected by an addition of hydrogen peroxide.

Anode corrosion is very good so that commercial nickel can be used for anodes. Due to the high temperatures and high acidity, there is very little tendency for the anodes to polarize. Consequently, high anode current densities are practical.

The plating rate can be increased by agitating the bath, and relatively heavy deposits can be obtained at high plating rates. The characteristics of the bath are similar to the high chloride iron bath, except that control is not as critical.

The nickel concentration of the bath can be controlled by gravity if desired. The pH of the bath is too low for pH control, but the acidity is easily measured by simple titration with standard alkali. The bath will tolerate iron up to at least 0.7 oz./gal. Small amounts of iron will codeposit with the nickel without harm. If the iron becomes too high it can be precipitated by oxidation with hydrogen peroxide and neutralization of the free acid with nickel carbonate.

The bath is subject to contamination by organic materials, but these can be removed by treatment with activated carbon followed by filtration.

Due to the high chloride concentration, high temperature, and high acidity, the bath will readily activate steel. Therefore, it is useful where it is desirable to insure an active surface for plating. The steel can be hung in the bath for a short time prior to plating in order to dissolve any iron that may have precipitated in the previous rinse. Or, an acidic holding tank can be used just prior to the nickel plating tank. Since the bath has a good tolerance for free acid and iron, the drag-in from such a holding tank will not readily contaminate the nickel bath.

Since the bath is operated hot and contains an appreciable amount of acid, it is more corrosive than a Watts type nickel bath. Thus, it will be necessary to avoid excessive exposure of rack parts or other metals that may come in contact with the bath. However, this high corrosivity accounts for good anode corrosion. This is advantageous when it is necessary to use small anodes, such as for plating on the inside of cylindrical parts.

The advantages of this bath are: good bath stability, high tolerance for acid and iron, simplicity of control and good anode corrosion. It is not a bath that one would expect to become popular, but it is a useful bath to have on tap. If a problem arises where an activating nickel bath is required, or where anode polarization is troublesome, this is a good bath to try.

CLEANING METALS AND ALLOYS

(Concluded from page 59)

Along with the developments of the buffing compounds, investigations of the synthetics has led to the developments of cleaning solutions which work fast and clean. These materials have been used in a number of industries with good results in many cases. It should be emphasized that the soluble type buffing compounds are no "cure all" for all the troubles encountered in metal cleaning, but are definitely an improvement in the field. In the meantime research work is continuing and methods are being sought whereby the buffing compounds can be made more water dispersible, with faster cutting and given more mileage. This will mean a reduction in cost of manufacture and at the same time less trouble for the plating department.

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SHOP PROBLEMS

ABRASIVE METHODS SURFACE TREATMENTS CONTROL
ELECTROPLATING CLEANING PICKLING TESTING

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

Acetic Acid-Salt Spray Test

Question: Please advise the most recently accepted salt spray solution formula. We understand there has been some acceptance of the five per cent salt, one per cent acetic acid mixture. Is the twenty per cent salt solution considered obsolete? The bulk of our testing is for copper, nickel, chrome on steel.

F. R. S.

Answer: The acetic acid-modified salt spray solution is a suggested alternative to the straight sodium chloride solution. Both solutions are in use but the latest A.S.T.M. standards call for a 5% solution in either case. A number of government specifications still call for the 20% solution, however.

The type of solution to be employed for the test is considered a matter to be settled between vendor and purchaser, as is the period of test. The acetic acid-sodium chloride test method is described in A.S.T.M. designation B 287-54T, copies of which are obtainable from the Society at 1916 Race St., Philadelphia 3, Pa. The advantages are pointed out in an excellent article by W. D. McMaster in the A.S.T.M. Bulletin of January 1955.

Hard Chromium Plating

Question: On pages 239-240 of the 1956 METAL FINISHING GUIDEBOOK is a table for preparing metals for hard chrome plating. In it you specify "thickness of deposit." Will you explain just what you mean by that? To deposit means to me that you are placing something on the surface. If this is so, why the limitation?

Incidentally, we mechanically clean rather than alkaline treat the majority of work of the clean surfaces with lacquer thinner prior to etching.

I would like to know what is the accepted and recommended method of preparing and starting aluminum bronze for:

1. 0.001" nickel, chrome build up
2. chrome build up.

In attempting to deposit metal on this type of surface (90% copper 10% aluminum) we have had erratic results with adhesion.

J. M.

Answer: There is a limitation to the thickness of chromium deposit which can be applied to metals because the deposit is very highly stressed and will tend to tear away from the base or crack excessively. The thicker the deposit, the greater the stress.

Many hard chromium platers clean mechanically instead of using an alkaline cleaner prior to etching. The etching is more important than the cleaning but the latter should be considered insurance since thinner may not remove oil or grease from small pits or recesses.

Aluminum bronze is always troublesome. Two possible procedures are suggested. A strong muriatic acid dip after cleaning and prior to plating is the first. The other is to strike in a solution of 2 lb./gal. nickel chloride and 1 pint/gal. muriatic acid, at 6 volts, room temperature, until the surface is covered with a thin deposit of nickel.

Air Force Certification

Question: We have been soliciting work from several of the aircraft manufacturers in this area and a few have questioned our holding certificates for plating cadmium and silver on military and aircraft parts. We would greatly appreciate any information you can furnish as to requirements and how and where such certificates may be obtained.

A. J. P.

Answer: To obtain Air Force certification, it is necessary to have the plating plant approved by an Air Force inspector and to submit plated test panels to an approved laboratory for thickness, adhesion, and salt spray tests. A certified report that the test panels have passed the required tests is then forwarded, after which an approval certificate is issued, the number of which is placed on shipments and invoices.

Your customers can refer you to the nearest Air Force office where details can be obtained or you can write to the Department of the Air Force in Washington, D. C.

Gold Plating on Nickel

Question: As a long time subscriber, I'd like to take advantage of your offer to help on technical problems. Can you recommend a method for the preparation of a nickel-plated surface for gold plating, to obtain adhesion of gold?

A. H. C.

Answer: If the surface is freshly nickel plated and immediately gold plated there is generally no trouble with adhesion. If the nickel plated surface has been allowed to stand around, it becomes passive, in which case it can be reactivated by a direct current strike at 6 volts and room temperature in a solution of 2 lbs./gal. nickel chloride and 1 pint/gal. muriatic acid. After the strike, the articles are rinsed and gold plated as usual.

Sulfuric Anodizing

Question: We would appreciate suggestions for processing machined aluminum die castings, which contain porous surfaces, through the usual sulfuric acid anodize process. As you may know, the electrolyte seems im-

possible to completely rinse out. This results in sulfate residues forming at the surface, which results in a speckled appearance on black dyed parts.

Would you recommend any of the following:

1. Change to black dyed chromic acid anodize
2. Vacuum impregnation of the casting with a resin sealant
3. Use of a wetting agent in the neutralizer tank
4. Extended rinsing in cold water with a high degree of agitation. Perhaps you could offer other suggestions.

R. L. F.

Answer: Although the treatments mentioned in your letter will offer some relief in reducing the entrapment of sulfuric acid, best results have been obtained in practice by soaking in a saturated solution of sodium bicarbonate at room temperature.

Copper Sulfate-Oxalate Bath

Question: Could you send me the formula for the recent double salt, copper sodium oxalate, non-poisonous type copper plating bath? The bath is made up with copper sulphate, sodium oxalate and triethanolamine.

C. M.

Answer: The copper sulfate-oxalate bath is neither new nor non-poisonous, although it does not contain cyanide. The bath, first suggested by Brockman & Brewer in 1936 for light flashing on steel instead of the cyanide bath, contains the following:

Copper sulfate	15	g./l.
Sodium oxalate	10	"
Triethanolamine	22	cc./l.

Production of Diamond Tools

Question: We are subscribers to METAL FINISHING and would appreciate very much if you could give us information on the following: We are manufacturers of plated diamond instruments and are using the same process for 10 years, which is not 100% satisfactory to us. It occurred to us that you must have information about the latest and best process in plating on diamonds to metal tools and we would be very much obliged if you could give us any information you have on literature, etc., consultants which are specialized and manufacturers of plating machines made expressly for this purpose.

F. B.

Answer: The production of diamond tools involves mechanical and handling problems rather than electroplating problems and we know of no manufacturer who offers the specialized, small scale equipment required for the purpose. Most operators make their own equipment. Present practice is to use bright nickel solutions and to chromium plate the finished tool to minimize sticking of the abraded material.

A list of consultants will be found in any recent issue of METAL FINISHING.

Rust Removal

Question: We have a problem in our museum of removing rust from antique plows, wagons and carriage tires, etc., where we can not soak in tanks due to the wood. Do you know of a good rust remover that can be applied and wire brushed, using a flexible shaft? The items will also have to be coated with a rust preventative.

F. H. W.

Answer: A 5% solution of phosphoric acid in water can be applied to the rusted areas for rust removal. The parts need only be wiped down after the acid solution has dried, as the acid leaves a rust inhibiting film on the surface. A film of clear lacquer can then be applied, or a rust inhibiting oil or wax, which is obtainable at most hardware stores and gunsmiths' shops.

(*Continued on page 70*)

Professional Directory

Science for Electroplaters

18. Electrolytes

By L. Serota

This is the second half of Part XVIII of this series. The first half appeared in our October issue.—Ed.

Thickness of Deposited Metal

The thickness of the deposited 201.2 grams of silver on the 5 sq. ft. area of the basis metal may also be determined. It is evident that such calculations will represent an average thickness of the plated coating rather than a uniform value for the surface. Reference to the density or specific gravity of the metal, which is available in standard reference sources, will provide the additional information required to determine the volume from which the thickness may be calculated. The specific gravity for silver is 10.5; hence the volume, in cubic centimeters, for the deposited 201.2 grams silver would be:

$$\text{Volume (in cc)} = \frac{\text{Weight (grams)}}{\text{Specific gravity (density)}} = \frac{201.2}{10.5} = 19.16 \text{ cc.}$$

Since 1 inch = 2.54 centimeters, 1 cubic inch (1" × 1" × 1") would be equivalent to 16.4 (2.54 × 2.54 × 2.54) cubic centimeters. The volume of 19.16 cc. of silver would therefore correspond to $\frac{19.16}{16.14}$ or 1.16 cubic inches. To convert the area 5 sq. ft. to square inches, multiply by 144 (12" × 12") or 5 × 144 = 720 square inches.

$$\text{Thickness} = \frac{\text{Volume}}{\text{Area}} = \frac{1.16}{720} = 0.00161 \text{ inch.}$$

The electrochemical equivalents, in Table 2, provide pertinent data for the elements common to plating tank operations. The data in several of the columns contain values which are convenient for rapid solutions of problems. These are obtained as follows:

I. Amp. hr. per sq. ft. to deposit 0.001" (inch):

length × width × thickness = cubic inches, cu. in.

silver: 12" × 12" × 0.001" = 0.144 cu. in.

0.144 × 16.4 = 2.35 cubic centimeters

2.35 × 10.5 (sp. gr.) = 24.675 grams silver

0.001118 × 3600 = 4.025 grams per amp. hr.

$$\frac{\text{24.675 (grams silver)}}{\text{4.025 (grams per amp. hr.}} =$$

6.2 amp. hrs. per sq. ft. to deposit 0.001" (inch)

one step:

$$\frac{12 \times 12 \times .001 \times 16.4 \times 10.5}{4.025} = 6.2$$

II. Grams deposited per ampere-hour (3600 seconds):

gram per amp.-sec. × 3600 = grams deposited per amp.-hr.

silver: 0.001118 × 3600 =

4.025 g. silver deposited per amp.-hr.

III. Thickness in inches 1 oz. per sq. ft.:

length × width × thickness × 16.4 × sp. gr. = 28.35 gr. (ounce)

cadmium: 12 × 12 × (T) × 16.4 × 8.65 = 28.35

$$(T) = \frac{12 \times 12 \times 16.4 \times 8.65}{28.35}$$

= 0.00139 inch cadmium per oz./sq. ft.

TABLE II

ELECTROCHEMICAL EQUIVALENTS

Calculated on Basis of 100% Cathode Efficiency

Metal	Symbol	Valence	Atomic Weight	Specific Gravity	Thickness in Inches of 1 oz./sq. ft.	Grams Deposited Per Amp. Hr.	Amp. Hr. Per Sq. Ft. to Deposits 0.001"
Antimony	Sb	3	121.76	6.68	.00180	1.514	10.4
Cadmium	Cd	2	112.41	8.65	.00139	2.0968	9.73
Chromium	Cr	6	52.01	7.1	.00169	0.3233	51.8
Cobalt (ous)	Co	2	58.94	8.9	.00135	1.100	19.0
Copper (ous)	Cu	1	63.54	8.93	.00134	2.371	8.89
Copper (ic)	Cu	2	63.54	8.93	.00134	1.186	17.8
Gold (ous)	Au	1	197,2	19.3	.00068*	7.356	6.2
Gold (ic)	Au	3	197.2	19.3	.00068*	2.450	18.6
Hydrogen	H	1	1.0080	0.0899 g./l.	—	0.0376	—
Indium	In	3	114.76	7.31	.00182*	1.427	12.0
Iron (ous)	Fe	2	55.85	7.87	.00153	1.042	17.9
Lead	Pb.	2	207.21	11.35	.00106	3.865	6.9
Nickel	Ni	2	58.69	8.90	.00135	1.095	19.0
Oxygen	O	2	16.00	1.429 g./l. (0°C.)	—	0.2985	—
Palladium	Pd	2	106.7	11.40	.00116*	1.990	13.5
Platinum	Pt	4	195.23	21.45	.00062*	1.821	27.8
Rhodium	Rh	3	102.91	12.5	.00106*	1.280	22.9
Silver	Ag	1	107.88	10.5	.00126*	4.025	6.2
Tin (ous)	Sn	2	118.70	7.33 (tetragonal)	.00164	2.214	7.8
Tin (ic)	Sn	4	118.70	7.3 "	.00164	1.107	15.6
Zinc	Zu	2	65.38	7.14	.00168	1.219	14.3

*These figures are for 1 troy ounce per square foot.

Current Efficiency

The amount of metal deposited during the passage of current through a plating solution will not necessarily be equal to the weight computed on the basis of the quantity of electricity indicated (ampere-seconds or ampere-hours). It is possible, for example, for two or more reactions to occur at the electrode at the same time. During the electrolytic process in a nickel (Watts) bath or a copper cyanide bath the deposition of the metal will very likely be accompanied by the liberation of hydrogen. In a brass plating operation, copper and zinc will be deposited and hydrogen liberated at the cathode. The amount of current required for the deposition of each of the elements will be governed by conditions such as the concentration of the solution and the current density. The total weight, however, of the deposited nickel and evolved hydrogen in the nickel bath, the copper and hydrogen in the copper cyanide tank, or the copper, zinc, and hydrogen in the brass plating solution, will be equal (equivalent) to the current passed through the solution required by Faraday's Law. The proportion (ratio) of the actual weight of the metal deposited for a given current compared to the weight which could be deposited according to Faraday's Law is termed the *cathode current efficiency*. If 34.2 grams of nickel are deposited when a current of 200 amperes flows through the nickel bath for 10 minutes, the cathode current efficiency will be:

$$W = \frac{I \times t \times \text{at.wt.}}{96{,}500 \times \text{valence}} =$$

$$\frac{200 \times 10 \times 60 \times 58.6}{96{,}500 \times 2} = 36.44$$

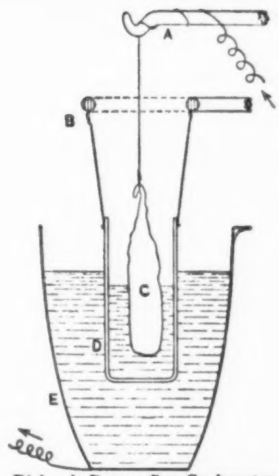
grams nickel, theoretical wt.

$$\frac{\text{actual wt.}}{\text{theor. wt.}} \times 100 = \frac{34.2}{36.44} \times 100 =$$

93.6% cathode current efficiency.

The remaining 6.4 per cent represents the weight of hydrogen that was liberated.

The weight of the deposited metal on the cathode for a definite quantity of electricity should provide the necessary information for determining the current efficiency. Satisfactory values cannot be obtained by this method, however, because of the fluctuation in the current during the period of deposition, the possible inaccuracy in the calibration of the ammeter, and the inexact recording of the time. It is preferable to use instead a solution from which the equivalent weight of the metal is known to be deposited by the passage of a faraday (100% current efficiency). Determinations of the faraday are thus obtained when the amount of purified silver nitrate is measured in a silver coulometer. Fig. 82 is a diagram of the Richard's porous porcelain cup coulometer. The solution should contain 10 to 20 grams of purified silver nitrate in 100 cc. of water, with a silver anode suspended in a porous cup and a platinum dish or cup as the cathode. The anode current density should not be more than 0.2 amp./sq. cm. and the cathode current density should be less than 0.02 amp./sq. cm.



Richards Porous Cup Coulometer.
A-Glass hook for supporting anode.
B-Glass ring for supporting porous cup.
C-Silver anode.
D-Porous cup.
E-Platinum cathode.

Fig. 82.

The copper coulometer is considered sufficiently accurate for laboratory measurements and is comonly used for such purpose. The solution contains 150 grams of crystallized copper sulfate, 50 grams sulfuric acid (sp. gr. 1.84) and 50 cc. ethyl alcohol made up to a volume of one liter with distilled water. Ethyl alcohol is used to appreciably reduce possible oxidation (Cu^{+} to Cu^{++}) which will occur at the surface of the solution with the oxygen of the air. The alcohol is oxidized to acetone and acetic acid. A convenient arrangement consists of a strip of copper, serving as the cathode, spaced evenly between two other copper strips which act as the anodes. The smaller cathode area and the recommended low operating temperatures tend to minimize the errors. A cathode current density range of 0.002 to 0.02 amp./sq. cm. is suggested. After electrodeposition, the cathode is washed with water and dried at 100°C.

A copper coulometer in series with a nickel bath and other baths should serve as an effective means for determining the amount of metal that should be deposited for a definite quantity of electricity, as required by Faraday's Laws. The ratio, therefore, of the actual deposit of metal to that calculated (theoretical) would be a measure of the cathode current efficiency. For example: current for a fixed time is sent through a nickel solution and a zinc solution, both in series with a copper coulometer. The weight for each deposited metal is as follows: copper 39.2 grams, nickel 32.1 grams, zinc 38.3 grams. The calculations for determining the cathode current efficiency are made in the following manner:

copper coulometer:

Grams copper deposited per amp hr. = 1.186 grams.

$$\frac{\text{weight copper}}{\text{g./amp. hr.}} \quad \frac{39.2}{1.186} = 33 \text{ amp. hrs.}$$

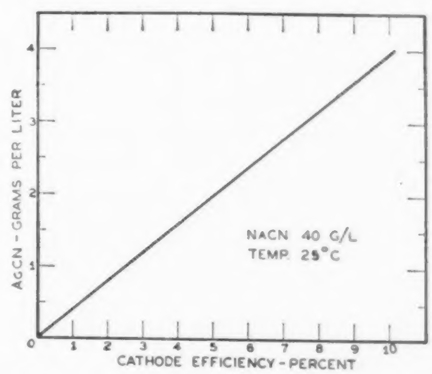


Fig. 83. The cathode efficiency of silver strike solutions at a current density of 40 amperes per square foot.

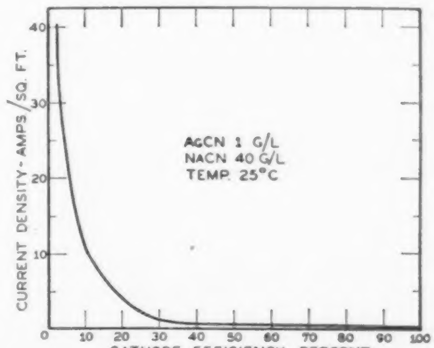


Fig. 84. Silver strike solutions. The variation of cathode efficiency with current density.

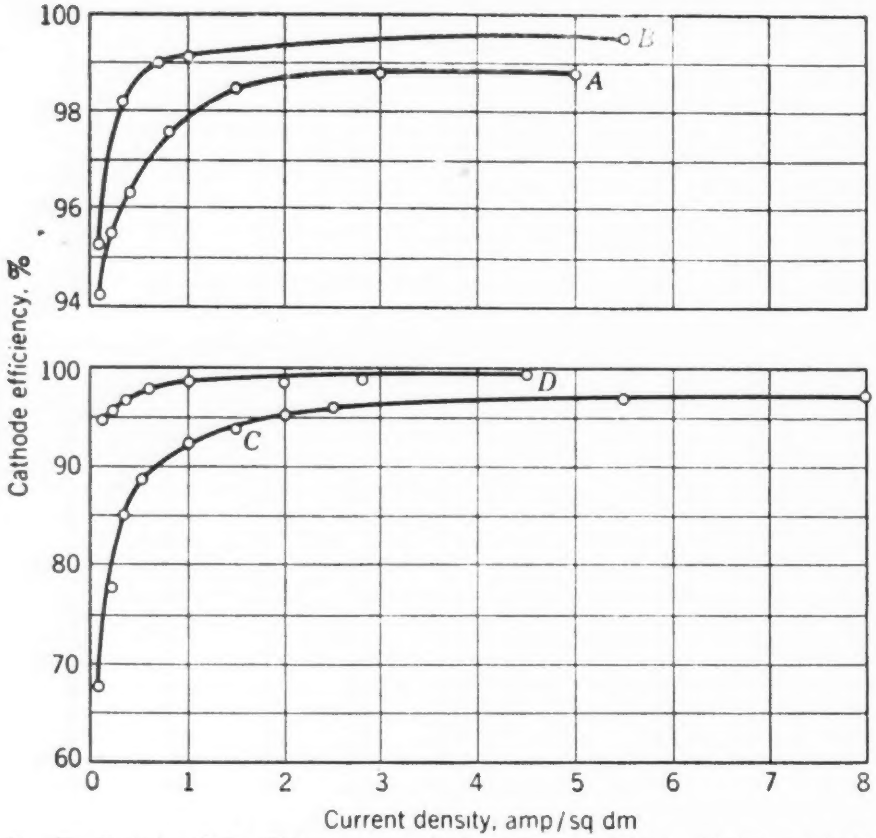


Fig. 85. Typical cathode efficiency-current density curves according to Wesley and Roehl: A, hard bath; B, Watts pH 5.5; C, Watts pH 2.0; D, Chloride bath.

Nickel:

Theoretical grams nickel deposited per amp. hr. = 1.095 grams.

Theoretical grams nickel deposited in 33 amp. hrs. = 33 × 1.095 = 36.1 grams.

$$\frac{\text{weight nickel deposited}}{\text{theoretical weight nickel}} = \frac{32.1}{36.1} \times 100$$

88.9% cathode efficiency.

Zinc:

Theoretical grams zinc deposited per amp. hr. = 1.219 grams.

Theoretical grams zinc deposited 33 amp. hrs. = 33 × 1.219 = 40.2 grams.

$$\frac{\text{weight zinc deposited}}{\text{theoretical weight zinc}} = \frac{38.3}{40.2} \times 100$$

= 95.2% cathode efficiency

Anode current efficiency cannot be determined with the same accuracy attainable for the cathode. The loss in weight of anode (anode dissolved) will not compare with the theoretical amount based upon a definite quantity of electricity. Such factors as particles of metal, metal (basic) compounds, carbon or other impurities which may become detached and remain insoluble or stick to the anode may cause inaccurate results. If loss by drag-out does not affect the results then, for a given quantity of electricity, a comparison of the metal concentration in a fixed amount of solution before and after the experiment may be used as a method of determining the relative anode and cathode efficiencies. The metal content will not show any change if the efficiencies for both electrodes are the same.

The relationship of cathode current efficiency to concentration is effectively demonstrated in a silver strike solution. With the current density kept constant at 40 amp./sq. ft. and the temperature of the bath maintained at 25°C., the cathode current efficiency of the solution, as shown in Fig. 83, is directly proportional to the concentration of the silver cyanide. The silver ions are being discharged as rapidly as the charged particles (silver ions) reach the cathode. Silver is, accordingly, more 'noble" than hydrogen in a cyanide solution.

That silver is more noble than hydrogen in a silver strike bath may also be demonstrated by a study of changes in current density. It will be observed in Fig. 84 that the cathode current efficiency for silver approaches one hundred per cent at a low current density.

Nickel plating baths provide additional examples of the effect upon cathode current efficiency based upon variations in current density. The graphs in Fig. 85 representing cathode efficiency curves for different nickel baths show that the efficiency increases with increasing curent density. The maximum (or limiting) current density is indicated by the horizontal part of the curves.

The effect of changes in current density upon the anode current efficiency can be shown from a study of a cyanide-stannate bath using bronze anodes (87.8% Cu + 12.2% Sn.). When the current density is increased to about 60 amps./sq. ft., the anode current efficiency is reduced from a high of 90% to a low efficiency of about 5%, a drop attributed to the formation of a film on the anode.

SHOP PROBLEMS

(*Continued from page* 67)

Zinc Plating Pipe Interiors

Question: We are making a complete project for galvanizing pipe to 4″ diam. and 21′ in length. We wish you to furnish us all information that you can give us about: 1) design of racks for the correct galvanizing of the inside surface; and 2) is it best to use alkaline or acid baths for this process?

G. G. A

Answer: If you use the cyanide zinc bath, steel rods will serve as inside anodes. If the acid zinc bath is employed it will be necessary to use lead coated copper to obtain sufficient conductivity. The acid bath is cheaper but the cyanide bath will give a brighter deposit.

Nickel Brighteners

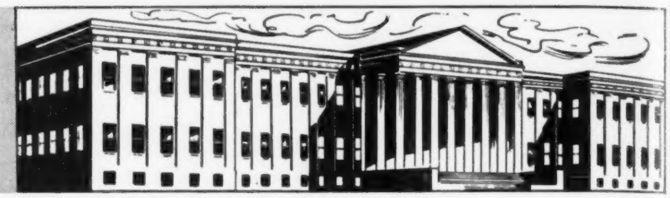
Question: I am interested in two saccharine products used in chromium and nickel plating: Leverbrite and Greeamex Leveller. I would appreciate receiving the name of the company which manufactures them.

G. G.

Answer: Our files indicate two bright nickel plating processes which are spelled slightly differently from the products listed in your letter. These are Levelbrite and Gleamax, both of which are sold by W. Canning & Co. Ltd., Birmingham 18, England.

Patents

RECENTLY GRANTED PATENTS IN THE METAL FINISHING FIELD



Copper-Tin-Zinc Bath

U. S. Patent 2,739,933. *March* 27, 1956.
M. Ceresa, assignor to Westinghouse Electric Corp.

In an aqueous alkali cyanide plating solution for electro-depositing a ternary alloy composed of from 50% to 75% copper, 15% to 35% tin, and 5% to 20% zinc on a metallic base member, an organic brightener comprising 1 - acetyl - 2 - thiohydantoin admixed with the solution in an amount of from 0.0005 oz. to 0.5 oz. per gallon of solution.

Conforming A[illegible]de

U. S. Patent 2,739,937. *March* 27, 1956.
C. W. Forestek.

A device for use in electroplating at least one selected external area of an article having external and internal surfaces, comprising; a surrounding anode corresponding substantially in bodily contour to the surface contour of said selected area to be plated; an aligning member, removably secured in rigid relationship to an enlarged external surface of said article; a second aligning member, removably secured in rigid relationship to said internal surface of said article; and means inter-connecting said anode with said respective aligning members, whereby said anode is freely suspended in mechanically and electrically equidistant relationship with respect to said selected area to be plated.

Flexible Abrasive Products

U. S. Patent 2,740,239. *Apr.* 3, 1956.
A. L. Ball, O. S. Buckner and P. C. Tucker, assignors to Bay State Abrasive Products Co.

A flexible, foraminous abrasive product comprising a base of an open mesh, woven fabric, both the warp and filling yarns forming said fabric being continuous filament yarns and having a coating thereon of a flexible, presizing material, said coating securing said yarns together at their points of interlacing and maintaining the respective warp and filling yarns substantially parallel, a coating of hardened bonding adhesive over the precoated yarns, and a layer of abrasive granules held on said yarns by said adhesive.

Continuous Hot Galvanizing

U. S. Patent 2,740,729. *Apr.* 3, 1956.
R. Hodil, assignor to Granite City Steel Co.

The method of producing a spangled galvanized sheet which comprises, introducing a continuous strip of the sheet material into a bath of molten zinc and continuously removing the strip vertically from the bath, passing the vertically progressing strip near its point of emergence from the bath between a pair of opposed arcuate nonrotating surfaces having radii of curvature in the order of 1¾" and which are partially submerged in the zinc bath, maintaining the arcuate surfaces in contact with the opposite sides of the strip so that such arcuate surfaces contact the strip along lines substantially directly opposite each other and which lie in a plane parallel to the surface of the molten zinc and which is at substantially right angles to the strip, and maintaining the level of the molten zinc fixed with relation to the lines of contact between the arcuate surfaces and the strip so as to obtain a continuously uniform coating upon the strip.

Zinc Brightener

U. S. Patent 2,740,754. *Apr.* 3, 1956.
R. A. Hoffman, assignor to Allied Research Products, Inc.

In a process for the electrodeposition of zinc, the step comprising depositing zinc from a cyanide-zinc plating bath containing from 0.001 to 0.0035% by dry weight of an aqueous additive solution comprising water, 44 to 60% by weight of anisic aldehyde bisulfite, 10 to 24% by weight of ground glue, 8 to 12% by weight of polyvinyl alcohol and 8 to 20% by weight of sodium lignin sulfonate said per cents by weight of anisic aldehyde bislulfite, ground glue, polyvinyl alcohol and sodium lignin sulfonate being on a dry basis.

Metallizing Non-Conductors

U. S. Patent 2,740,731. *Apr.* 3, 1956.
W. O. Lytle and A. E. Junge, assignors to Pittsburgh Plate Glass Co.

A method of providing a refractory base with an electroconductive coating which comprises heating the base to a temperature above about 400°F. but below the temperature at which the base becomes molten, and applying to the hot base a fluid dispersion of an indium salt and an ionizable fluoride.

Electropolishing Bath

U. S. Patent 2,740,755. *Apr.* 3, 1956.
D. E. Couch and A. Brenner, assignors to the United States of America.

The method of electropolishing various metals selected from the group consisting of aluminum, copper, brass, stainless steel, zinc, silver, molybdenum, cadmium and nickel which comprises connecting the metal to be polished as the anode in a bath consisting essentially of between 60 to 100 per cent by weight of phosphorous acid, and passing an electric current of from 5 to 100 amperes/decimeter^2 between said anode and a cathode.

Composite Bearing and Method of Making Same

U. S. Patent 2,741,016. *Apr.* 10, 1956.
A. E. Roach, assignor to General Motors Corp.

In a method for making bearings comprising a bearing member including aluminum as its major constituent and having an overlay of a lead-base alloy consisting of at least 82% lead covering one surface of said bearing member, the steps comprising: chemically etching a surface of said bearing member in a caustic solution, superimposing an acid etch upon said clean-

ed and caustic etched surface, plating the etched surface with a layer of zinc, plating a layer of silver having a thickness not in excess of .0001″ on the zinc layer, and finally coplating a bearing alloy onto the surface of said silver, said bearing alloy consisting of lead in quantities of at least 82% therein.

Metallic Coating for Wire

U. S. Patent 2,741,019. *Apr.* 10, 1956. *C. L. Faust, assignor to the United States of America.*

A solderable copper wire conductor of high resistance to humidity and fungal growth comprising a first coating of an electrodeposited lead film of a thickness from 0.00003 inch to 0.00006 inch and a second coating of electrodeposited tin having a thickness from 0.000005 inch to 0.00002 inch.

Etching Aluminum

U. S. Patent 2,741,051. *Apr.* 10, 1956. *W. A. Reissig, assignor to Allied Chemical & Dye Corp.*

The process of etching a body of aluminum comprising contacting such a body under etching conditions with an aqueous solution of a caustic etching agent containing sodium lignosulfonate.

Gas Plating

U. S. Patent 2,741,216. *Apr.* 10, 1956. *H. A. Toulmin, Jr., assignor to The Commonwealth Engineering Co. of Ohio.*

Apparatus for gas plating of continuous cast metal immediately upon removal of the casting from the mold and utilizing residual heat from the casting operation, said apparatus comprising a plating chamber arranged adjacent said mold and through which said continuously cast metal is advanced as the same is withdrawn from said mold, said plating chamber comprising an inlet and an outlet for the circulation of heat-decomposable gaseous metal therethrough, ports in said chamber aligned for vertical passage of the casting therethrough, means for sealing the ports comprising a chamber portion surrounding each of said ports, and inlet and outlet means for circulation of inert gas to said sealing means, said chamber portion having ports aligned with the ports in the plating chamber, all of said ports providing a close sliding fit with said casting.

Electrotinning

U. S. Patent 2,741,585. *Apr.* 10, 1956. *D. S. Medcalf, assignor to United States Steel Corp.*

In the operation of an electrotinning line, a method of marking the strip comprising moving uncoiled strip in a path, contacting portions of one side of the moving strip with a rotating burnishing brush of less width than the strip, while leaving other portions of the same side transversely of the burnished portions free of such contact to form a pattern of individually visible stripes, and subsequently electroplating both sides of said strip, the striped pattern remaining visible after plating.

Pickling Waste Recovery

U. S. Patent 2,741,250. *Apr.* 10, 1956. *C. A. Rauh.*

In a continuous process of pickling steel and the like with a heated aqueous sulfuric acid pickling solution, the cyclic steps of passing a stream of reconditioned pickling solution produced in a subsequent step at desired temperature and acid content continuously in contact with the metal being pickled, thereby forming a used pickling solution; continuously concentrating a first portion of said used solution by direct contact flame heating to effect crystallization of a ferrous sulfate salt therein; separating the resultant concentrated solution and ferrous sulfate crystals; combining a second portion of said used solution and said concentrated solution with makeup acid and water being introduced to the process; and continuously bringing the combined solution into intimate contact with the water vapor and combustion products arising from the concentration step to condense and absorb water vapor therefrom thereby producing and heating said stream of reconditioned pickling solution.

Plating Barrel

U. S. Patent 2,741,463. *Apr.* 10, 1956. *L. E. Colclesser, assignor to Mercil Plating Equipment Co.*

A plating barrel comprising a body portion including a plurality of sides formed integral with one another and of plastic material, each of said sides intermediate the longitudinal edges thereof being deformed radially in-

wardly of the body portion substantially throughout the length of each side to provide increased strength therefor and each of said sides having the innermost extending portions thereof circumferentially offset from the longitudinal edges thereof and presenting gradually inclined inner surfaces to aid tumbling action within the barrel, a pair of end plates mounted on and closing the ends of said body portion, a plurality of separate retaining strips spaced peripherally around and mounted on the inner surface of each end plate and projecting axially toward one another, there being a retaining strip for each said inwardly deformed side of the body portion, and each said retaining strip having inwardly directed inner edges shaped to conform with and contact the outer surface of the corresponding side of the body portion along the inwardly deformed outer surface thereof for holding the sides in their predetermined shape and position, and means disposed adjacent the retaining strips for securing the body portion to the end plates.

Superimposed A.C. Plating

U. S. Patent 2,741,586. *Apr.* 10, 1956. *B. J. Sherwood, assignor to North American Aviation, Inc.*

A method for electroplating uniform deposits of material upon an electrode in a plating solution which consists of passing an alternating plating current of asymmetric sine wave form through said plating solution, the positive plating half cycle being greater than the negative de-plating half-cycle of said current in amplitude and being equal in time duration, whereby said metal is plated in a bright deposit upon a base metal.

Bright Acid Copper Bath

U. S. Patent 2,742,412. *Apr.* 17, 1956. *R. Cransberg and H. A. Van Oosterhout, assignors to N. V. Metallic Industry.*

A bright copper plating bath comprising copper sulfate, sulfuric acid, a brightener in a proportion of 5-50 mg./liter, said brightener being selected from the group consisting of thiourea allythiourea and acetylthiourea, and a filler selected from the group consisting of glycerol, glycol, ethylene glycol mono ethyl ether and diethylene glycol mono butyl ether.

Abrasive Wheel Assembly

U. S. Reissue Patent 24,143. *Apr.* 17, 1956. *G. O. Leggett, assignor to Merit Products, Inc.*

As an article of manufacture, an annular pack of juxtaposed flaps, and means adhered to said flaps maintaining them circularly disposed around a central, circular space, alternate flaps of said pack each having a face coated with an abrasive substance, and the intervening flaps each having smooth faces.

Hot Dipping Metal Strip

U. S. Patent 2,742,019. *Apr.* 17, 1956. *W. C. Queer, Sr., assignor to Inland Steel Co.*

In an apparatus for coating a metal strip with molten metal by passing the strip through a coating bath and thence between a pair of coating rolls, the combination of a pair of coating rolls, support means for rotatably supporting said rolls in substantially parallel relation, the support means for at least one of said rolls comprising a rock shaft and a pair of support members rigidly carried adjacent the ends of said shaft and having said one roll journaled therebetween, said rock shaft being rotatable about its axis for movement of said one roll toward and away from the other roll, and means operatively coacting with said support means for said one roll for yieldably urging said one roll toward the other roll under predetermined pressure.

Etching Tantalum

U. S. Patent 2,742,416. *Apr.* 17, 1956. *A. L. Jenny, assignor to General Electric Co.*

The method of electrolytically etching tantalum which comprises making the tantalum the anode in an electrolyte solution consisting of formamide, dimethyl formamide, from 9,500 to 11,500 parts per million by weight of water, and sufficient of ammonium bifluoride dissolved therein to provide a solution having a conductivity capable of passing a current therethrough.

Progressive Strip Plating Machine

U. S. Patent 2,742,417. *Apr.* 17, 1956. *J. J. Shanley, assignor to National Steel Corp.*

Apparatus for progressivley electroplating a surface of successive lengths of strip of the same and different widths.

Bright Acid Copper Bath

U. S. Patent 2,742,413. *Apr.* 17, 1956. *R. Cransberg and H. A. Van Ooosterhout, assignors to N. V. Metallic Industry.*

A bright copper plating bath comprising copper sulfate, sulfuric acid, a brightener in proportion of 5 to 50 mg. per liter of solution, said brightener being selected from the group consisting of thiourea, allylthiourea and acetylthiourea, and a filler selected from the group consisting of xanthine and its methyl homologues, hexamethylene tetramine, pyridine and morpholine.

Tin Plated Copper Wire

U. S. Patent 2,742,687. *Apr.* 24, 1956. *W. P. Ruemmler, assignor to the United States of America.*

A tinned copper wire conductor characterized by a markedly low content of tin compared to conventional tinned wire said content being a small fraction of the amount used in conventional tinned wire, and being characterized by inhibition of interfacial chemical and inter-crystalline combination of the copper and tin, and being also characterized by the presence of a barrier to chemical deterioration of conventional insulation coating when applied to said conductor; said conductor consisting of a copper wire core base, an electro-deposited iron barrier layer thereon having a thickness of about 0.00003 inch, and a layer of electrodeposited tin on said iron layer having a thickness of between 2.5×10^{-6} and 5×10^{-6} inch.

ABSTRACTS

Periodic Current Reverse with Copper Plating Critical Considerations

E. Gerber: *Metalloberflaeche.* Vol. 6, No. 11, B161.

Although it was back in 1925 that periodic reverse current was first applied by Holt with the prime object of reducing the hydrogen content of thick nickel coatings, the effect obtained was not really satisfactory. The

deposit showed pronounced lamination and interruption of the normal crystal structure. This action on the crystal structure is typical when plating with periodic reverse current and the destroyed crystal structure growth is not always a disadvantage for the quality of the deposit. It has been established that plated coatings produced in this manner, in spite of the laminated structure, are superior, as regards surface smoothness and ductility, to the bright plated coatings produced by additions to the electrolyte.

Although the deposits with periodic reverse current are often obtained in the bright form as from bright plating baths, nevertheless, in their characteristics they are always fundamentally different from the former. For instance, the crystal lattice disturbances caused by the brightener additions are always absent. Consequently, periodic reverse current should be employed when ductile deposits are required with no great hardness or internal stress. One special characteristic of the process is the higher current densities which can be imposed; this, perhaps, may be regarded as one of the principal commercial advantages of the process. Thus, the normal attainable current density with a Rochelle salt-cyanide copper bath is 7.5 amp./sq. dm. With p.r. this can be increased to 12 amp./sq. dm. That for an acid copper bath with p.r. is 20-30 amp./sq. dm. Current densities up to 100 amp./sq. dm. can be applied in wire plating.

The p.r. process is particularly favorable for silver baths, as here the normal low current density can be raised considerably. Periodic reverse current has also been found applicable for chromium plating. As a result of the higher current densities used, there is a general better throwing power of the baths. There is also greater certainty in the production of coatings with lower hardness differences. Further, with the use of the p.r. process with bright baths, the brightening agent additions in these baths can be reduced considerably and consequently the brittleness of the deposits reduced.

Buffing and Polishing of Internal Surfaces

P. Woehler: *Metalloberflaeche.* Vol. 6, No. 11, B162.

Of the materials used for the finishing of internal surfaces by buffing and polishing, cotton cloth and felt are particularly suitable. On the first, glue and buffing medium will adhere firmly so that a strong head is achieved which is sufficiently pliable and elastic to provide an effective buffing action. In general, a cloth wheel for internal polishing should be always larger than the diameter of the internal surface being processed. Where a limitation to the minimum size is necessary, felt should be used. The wheels are applied on a tapered or screwed spindle and should be run at a lower speed than for the handling of external surfaces. The reason for this is that the internal surfaces have more contact with the polishing wheel and tend to heat up more.

In order to create a contact surface of the wheel with the material which is as large as possible, either a smaller diameter can be used or the wheel can be held to the work at another angle. The speed of the wheel is determined: (1) By the type and nature of the material being polished; (2) By the size of the article and its wall thickness; (3) The degree of handling required; (4) By the buffing and polishing medium used. Care must be taken that the polishing paste does not become ineffective too quickly by being thrown off, or by glazing on the wheel. Scraping off and re-application is necessary more frequently with internal surface polishing.

For the various shapes of internal surfaces the following head types have given satisfactory results with the polishing:

Internal Surfaces	Wheel/Head
Spherical shaped	Bowl shaped with round head
Angular such as junction of bottoms and sides	Bowl shaped with square head
Insides with irregular contour	Pointed shape or bowl shape
Insides running-together to a point	Cylindrical shape
Insides at an angle	Pointed shape
	Pointed shape, bowl shape or a narrow wheel shape.

Most of the articles will fall under these shapes. For felt wheels, pointed shapes should be used or cornered shapes with articles which require the smaller wheels.

The Hull Cell for Testing and Control of Plating Baths

E. Gerber: *Metalloberflaeche.* Vol. 6, No. 4, B51.

Comprehensive tests were made with the Hull cell. After detailed data were obtained on the operation of the cell and conducting of the test, it was found that the most important bath constants which can be controlled in the plating baths in most common use are:

1. *Bright Nickel Bath:* Nickel content, brightening agent (primary and secondary), boric acid, wetting agent, as well as the presence of organic decomposition products and metallic impurities such as zinc, copper or iron.
2. *Chromium Bath:* Above all, here is tested the ratio of sulfuric acid to chromic acid; also, any subsequent contamination nickel as well as iron and trivalent chromium.
3. *Potassium Cyanide Copper Bath:* Approximate composition, cyanide content, carbonate content, pH value, impurities such as lead, iron and zinc.
4. *Brass Plating Bath:* Ratio of copper and zinc, free cyanide, pH, and color of deposit.
5. *Bright Zinc Bath:* Zinc content, ratio of zinc to sodium cyanide, caustic soda content, brightening agent, impurities, such as copper, lead and cadmium.
6. *Bright cadmium Bath:* Cadmium content, cyanide content, caustic soda content, carbonate content, brightening agent and impurities comprising lead, copper, zinc and chromium.

Determination of Fluosilicic and Fluoboric Acids

F. Karstem: *Metalloberflaeche.* Vol. 6, No. 4, B53.

Chromium baths are often operated with fluosilicic acid instead of sulfuric acid. They have the advantage that the current efficiency at equivalent temperature, current density and chromic acid concentration is always higher than with the sulfuric acid bath. As with the sulfuric acid bath, the concentration of the fluosilicic acid should not exceed a certain figure. The determination can be undertaken by the precipitation of calcium fluoride after treating with caustic soda.

For the analysis, 20 cc. of the test solution are diluted in a 200 cc. volumetric flask with 20 cc. of water and heated on the water bath to 30-40°C. 25% caustic soda solution is added with agitation until the solution has a definite alkaline reaction with litmus. Disturbing metals are removed in this way and soluble sodium fluoride formed. The solution is cooled and diluted to the mark with water. After mixing well, it is allowed to settle and 100 cc. are filtered into a dry 100 cc. volumetric flask. It is then placed in a 400 cc. beaker and made just acid with hydrochloric acid. Then 100 cc. of a carbonate-free pure calcium chloride solution are added and the solution made just alkaline to litmus with ammonia. The solution is then acidified with acetic acid until the characteristic color of the dichromate is formed but any great excess is avoided. Any calcium carbonate present in small amount is dissolved by the acetic acid, but the calcium fluoride is not. The solution is warmed until the calcium fluoride has coagulated, then filtered and washed with a little water. The filter and precipitate are then placed in a beaker and the calcium fluoride dissolved with 5 cc. of a 50% hydrochloric acid solution. After the addition of 250 cc. of hot water, 5 g. ammonium chloride and 5 g. ammonium oxalate, the solution is boiled for 1 minute and again filtered. The precipitate is washed with lukewarm water, placed in a beaker, and 100 cc. of a hot 5% sulfuric acid solution added. The oxalic acid formed is then titrated with N/10 potassium permanganate.

The determination of free fluoboric acid in plating baths such as copper, for example, is conducted by diluting 10 cc. of the test solution with 150 cc. of water and adding a few drops of cresol-red indicator. The solution is then titrated with 1N caustic soda until the violet blue color changes to a greenish blue.

cc. NaOH used x $8.790 = $ g./l. HBF_4

The change of the indicator in noncolored solutions is from red to yellow. In solutions containing cupric ions, the color change is from violet to blue-green.

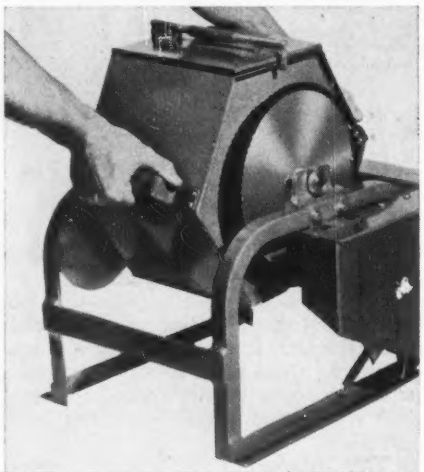
In fluoborate lead baths, the free acid is determined in the same way by titration with 1N caustic soda, but the addition of the indicator is not necessary. The titration is continued until the first appearance of a cloud.

Recent Developments

NEW METHODS, MATERIALS AND EQUIPMENT FOR THE METAL FINISHING INDUSTRIES

Tumbling Barrel

Chicago Wheel and Mfg. Co., Dept. MF, 1101 W. Monroe St., Chicago, Ill.



Designed for deburring and finishing small parts, the new Handee Slide-Abrader is effective as well as low in cost. According to the above manufacturer, the new machine will pay for itself after fifteen runs.

The unit is precisely engineered for deburring, radiing, and finishing of small parts. It is of rugged construction, has three-speed drive, an automatic timer, and is portable. Novaculite, as well as all conventional types of tumbling media and compounds can be used with the machine, for the exact finish required.

54/Circle on Readers' Service Card

Black Zinc and Cadmium Finish

Conversion Chemical Corp., Dept. MF, Rockville, Conn.

A new intense, dull black finish, known as Kenvert No. 11-B, for use on zinc die castings provides excellent corrosion resistant properties when applied on the appropriate conversion coating for the particular metal to be finished. The process is designed to produce a uniform dense black finish on zinc, cadmium or zinc-base die castings. It is claimed to be fast, can be conducted at room temperature, requires no exhaust equipment, and features a cycling period which can be adjusted to automatic machine operation.

The base chromate coating of a metal to be finished can be made thicker, denser, and harder than those obtained by previous methods, and the result is a greater absorption of the material for a durable, lasting finish.

55/Circle on Readers' Service Card

Alkaline Scale Remover

Enthone, Inc., Dept. MF, 442 Elm St., New Haven, Conn.

A new product, Alka-Deox 109, for the electrolytic removal of scale and oxides from iron and steel, is said to remove scale quickly with no chemical attack on the iron or steel because of the alkaline nature of the chemical.

The new product is said to be particularly adaptable to plating lines and automatic equipment involving alkaline or alkali-cyanide plating solutions. In such installations, no acids are required and, therefore, equipment corrosion from acid fumes is completely eliminated.

The material can be adapted to present equipment without difficulty and, when planned for new equipment, it can substantially reduce the equipment costs. It is quite suitable for use in barrel plating lines.

56/Circle on Readers' Service Card

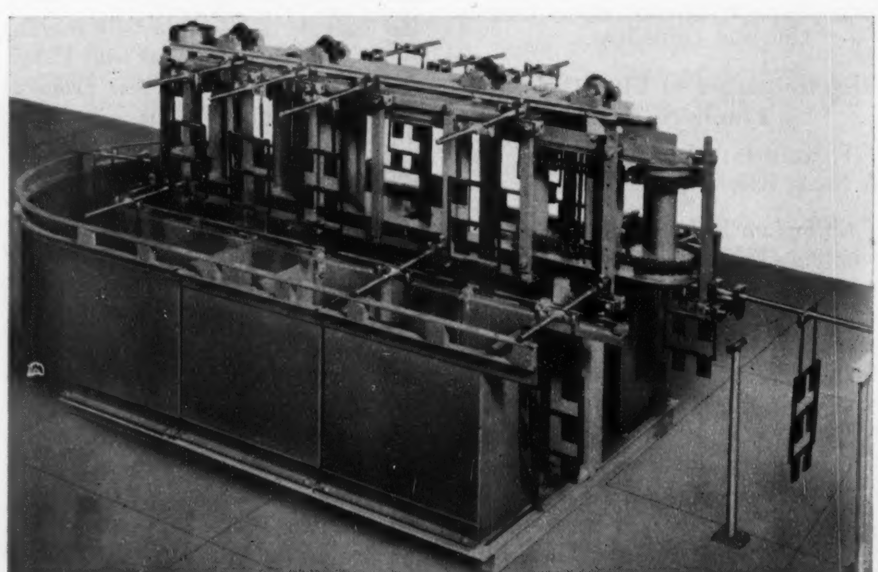
Automatic Plating and Anodizing Machine

Lasalco, Inc., Dept. MF, 2818 La-Salle St., St. Louis 4, Mo.

A new, extremely versatile, fully automatic plating and anodizing machine, called the Cycleflex, is stated to eliminate the expense of overhauling or rebuilding during cycle changing. Only the positions of pick-up heads require changing, plus minor tank partition changes. A simplified safety device and electro-mechanical control eliminate possibility of conveyor malfunction and make it impossible to push racks into side of tank, or prevents load from dropping if power fails during work transfer.

Other features include self-cleaning, heavy-duty contacts with positive 3-point contact; removable rack carriers that leave tank surfaces clear for easier servicing and manual plating of large pieces. Contacts and elevating mechanism are not over solution, thus reducing corrosion affect.

The machine can be equipped for



automatic loading and unloading of parts from standard double-spine racks which can remain on machine while parts are unloaded. Hydraulic operation is standard and pneumatic operation optional. Speed control on lift and transfer is standard.

59/Circle on Readers' Service Card

Non-Cracking Rhodium Plate

Sel-Rex Precious Metals, Inc., Dept. MF, Belleville, N. J.

A new rhodium plating process is said to produce compressively stressed deposits, eliminating curling, cracking and peeling common in conventional rhodium electroplate. Known as Rhodex -CS- (compressively stressed rhodium), the new process is expected to be of special interest to electrical and electronic manufacturers who have long been plagued with rejects of rhodium plated components due to this metal's high tensile stress characteristics.

According to the above manufacturer, the process has been subjected to extensive tests and experimentation, necessary for the filing of the patent application, which is pending. One of the most graphic of these tests entailed dissolving the basis metal from an object plated with conventional rhodium (see photo).

Company engineers state that, in

The compressive stress of Rhodex (compressively stressed Rhodium) and the high tensile stress of conventional rhodium electroplate is graphically demonstrated in this photograph.

Dissolving the basis metal from two rhodium electroplated brass strips in this pyrex dish caused the conventional rhodium electroplate (left) to disintegrate into small crystalline flakes. The new electroplate (right) remained unimpaired, and in a continuous film.

addition to the obvious advantages of this new process it will materially increase the fatigue resistance of the metal over which it is deposited.

60/Circle on Readers' Service Card

Polishing and Buffing Machine

Oswald Manufacturing Co., Dept. MF, 50-17 47th Ave., Woodside 77, L. I., N. Y.

This new semi-automatic polishing and buffing machine is claimed to be a novel method of approaching the mechanical finishing of metals. The machine hangs from the ceiling directly over the polishing lathe. It does not require a heavy duty lathe, and can be used with present equipment. The operator controls the pressure and motions similar to a hand operation, but does not have the weight of the piece nor the pressure of the buff to tire him, according to the above manufacturer. The work is power driven through a reduction gear. Set-up time from job to job is five minutes. No contour wheels are needed.

A spindle speed of 14 RPM is supplied for irregular shaped parts; for round or circular parts, 29 RPM. Production speeds of several hundred pieces per hour are said to be possible.

61/Circle on Readers' Service Card

Liquid Rubber Paint

Adhesive Products Corp., Dept. MF, 1660 Boone Ave., New York 60, N. Y.

Apco liquid rubber paint is claimed to have excellent adhesion to metal, wood, plastic, and concrete. When dried, it forms a continuous rubber film which prevents corrosion. Moisture and rain do not penetrate. This film is not affected by acid or alkali, nor is it affected by fungus.

The paint is waterproof, remains flexible, and will not peel or flake like ordinary paints. It can easily be applied by brush or spray. It is self-vulcanizing, requires no mixing, and adheres tenaciously to the surfaces coated. It dries in twenty to thirty minutes and,

62/Circle on Readers' Service Card

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when properly applied, will withstand five to ten years of use.

The coating is stated to be resistant to oil, gasoline, naphtha and many other solvents, and is one of the few paints that can be used for painting anything from oil-treated shingles to steel boat hulls. It is available in pint, quart and gallon containers and in 55-gallon drums.

64/Circle on Readers' Service Card

Portable Dust Collector

Hammond Machinery Builders, Inc., Dept. MF, 601 Douglas Ave., Kalamazoo, Mich.

Known as the Model 40, using a ½ H.P. motor, and mounted on casters for easy portability, the new Dus-Kolector is described as low in cost, compact, efficient, and requiring a minimum of space. It can be "tucked in" around machine tools. Cabinet size is 25" wide x 22" deep x 28" high. Shaft with hand knob provides convenient means of "shaking" filters for cleaning, and without removing them from cabinet. Front panel easily removed for access to replace fiber glass filters and dust pan in bottom of cabinet.

With two inlets, the Model 40 has a capacity of 700 C.F.M., and can be used with two size 16" x 2" grinding wheels or two 4" wide abrasive belts. Advantages claimed are protection of the operator and of nearby tools from abrasive dust, reduction of cleaning

and maintenance time, longer tool life, and rapid repayment of the original investment.

The company also manufactures portable filter type cabinet dust collectors in two other sizes, a smaller unit with a 330 C.F.M. capacity and a larger unit with 1000. Completing the line are four cyclone type units with C.F.M. capacities ranging from 500 to 2000.

65/Circle on Readers' Service Card

Plating Non-Conductors

Acheson Colloids Co., Dept. MF, Huron, Mich.

A new 'dag' dispersion, No. 235, a colloidal dispersion of metallic copper in a lacquer solution that provides a highly conductive surface coating, is suggested for printed circuitry, electroplating of non-conductors, and for application on components for such products as radar equipment, hearing aids, and electronic measuring devices.

The new copper dispersion is considerably cheaper than other coatings such as silver paint. It is also more easily applied than copper foil which, in the production of printed circuits, for instance, has to be laminated onto the plastic base and then etched away after the circuit has been printed with asphaltum.

Application of the material may be by spray or brush with dilution in the ratio of two parts of the product to one part of thinner for spraying and only a slight dilution of the concentrated material for brushing. A stiff brush should be used since a soft brush will permit the copper to settle to the under-

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FEATURES OF THE STEVENS SUPER "E"
AUTOMATIC BARREL PLATING AND PROCESSING MACHINE

Designed for the plating or processing of bulk metal parts in large volume. It provides a complete processing cycle of cleaning, acid, strike, plating, rinses, bright dip, chromate dip and drying—all fully automatic, and in one return type unit.

Stevens Automatic Barrel Machines are now being used for copper, tin, cadmium, zinc and nickel plating. They are also now in operation for cleaning, washing, phosphating, stripping, alroking, lubriting and many other similar types of immersion processing.

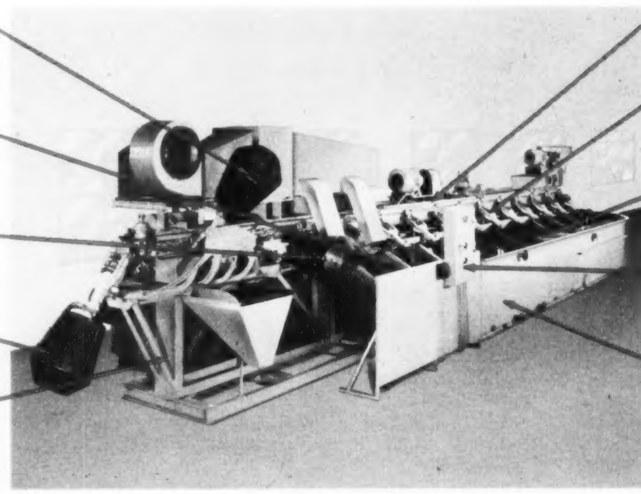
Automatic Load and Unload — is possible since there are no barrel lids to manually open or close.

Waste Control Minimized — because of less dragout, a minimum spillage factor and controlled rinsing.

Less Dragout — is positively assured. Simple, clean construction of cylindrical barrel reduces costly solution carry out.

Guaranteed Production Output — is ensured and known in advance with pre-determined barrel loads.

Low Cost Installation — is possible because mechanism is 100% pre-assembled.



Mechanical Flexibility—resulting from the machine's inherent mechanical simplicity, permits rapid process and production changes.

Minimum Barrel Maintenance — is possible since no gears or other moving parts are ever below solution level.

Human Control Eliminated — because of automatic control of process times, temperature and other variables.

Precision Quality Plating — is a certainty because all operating conditions are pre-determined and automatically controlled.

Longevity and Dependability — are confirmed by the testimony of hundreds of users operating machines far beyond the end of depreciation schedules.

FEATURES OF THE NEW STEVENS-DISTRIBUTED ROTO-MERSION
AUTOMATIC BARREL TUMBLING AND FINISHING MACHINE

What is Roto-Mersion? It is submerged automatic Roto-Finishing. The well known Roto-Finish Processes are now teamed with the new Roto-Mersion Automatic Barrel Processing Equipment. Both are backed up by years of experience and the most complete experimental testing laboratory in the country.

In checking the many important advantages to be gained from using the new Roto-Mersion Machine, be sure to weigh these features:

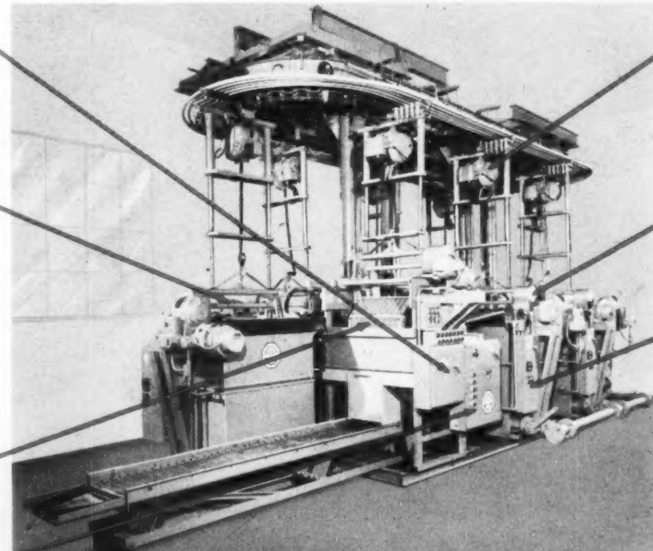
Processing Flexibility—is possible simply by changing chips, compounds and resetting of timing controls.

Greater Economy—results from ability to use compounds and solutions throughout their effective lifetimes.

Large Volume Production — is possible because of continuous automatic operation.

Continuous Production — as loading and unloading are done while processing continues in other tanks.

Full Automatic Control — can be had by using card or tape operational control systems.



Low Finishing Cost Per Piece — offers tremendous savings over standard systems and is possible because of maximum controlled production, minimum handling and savings in compound usage.

Maximum Safety — is insured for both personnel and machine through use of special controls regulating vertical and horizontal transfer.

High Quality Control Standards — can be maintained because of minimum handling and absolute pre-determination of finish specifications.

One-Man Operation—is possible since one complete cycle will clean, descale—grind or burnish, rinse and rustproof parts with no intermediate handling.

side of the film, leaving an excess of lacquer on its surface. Dip coating is not recommended. No baking is required. The film will air-dry and can be handled within a few minutes. Adhesion may be improved by mechanical pre-treatment (vapor-blasting, sandblasting, etching, etc.) where necessary.

66/Circle on Readers' Service Card

Hot Tin Process

Somers Brass Co., Inc., Dept. MF, Waterbury, Conn.

A special hot tin plate process is claimed to provide the smooth surface, solderability, adhesion and complete absence of slag so essential to manufacturers of printed circuits, capacitors, and cable wrappings. Tin coatings of .00002 to .00008 and .0002 to .0003 are available on brass, copper, bronze and other thin strip metals in gauges from .012 down to .002, widths from 1/8" to 6" and wider.

67/Circle on Readers' Service Card

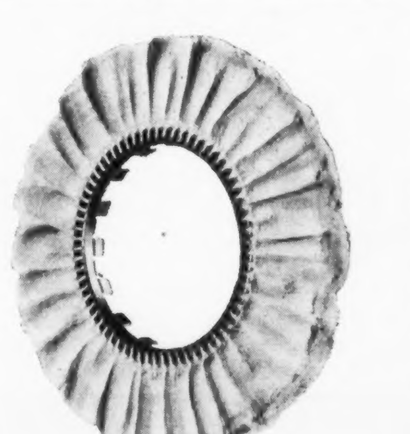
Open Bias Sisal Buff

American Buff Co., Dept. MF, 2414 S. La Salle St., Chicago 16, Ill.

Extra flexibility, longer wear and cooler running, the three buffing assets most demanded by metal finishing plants, are now available in a single buff, the new centerless open bias sisal buff, according to the above manufacturer.

The best features of both bias sisal and bias cloth have been combined with a patented centerless construction. The result is an air-cooled buff with a ruffled face that eliminates trouble-some streaking and permits fast cutting with high luster finishing of flat, curved or contoured surfaces.

The new buffs are made of top-grade, bias-cut sisal fibers, locked together to eliminate frayed ends and scratching. Centerless steel rings hold buff units securely in place.



69/Circle on Readers' Service Card

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Multi-Column Demineralizer

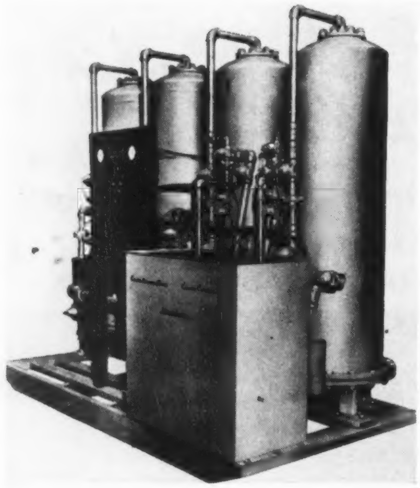
Penfield Mfg. Co., Dept. MF, 19 High School Ave., Meriden, Conn.

The new, fully automatic LA-1,000 unit, which operates on multi-column ion exchange principles, passes the raw water through four columns: two each, alternately, of cation and anion resins. The third and fourth columns remove the more weakly ionized impurities that may have passed through the first cation and anion columns. Thus, effective removal of free CO_2 and silica is accomplished and an effluent of exceptionally high purity is provided.

All operating functions are automatic. When the effluent's purity falls below the desired standard originally set by the operator, the unit automatically stops delivering treated water and the need for a regeneration cycle is signalled. The regeneration cycle is initiated by setting one switch and completes itself entirely automatically, including rinsing and recutting in the effluent when the pre-set standard of purity is attained.

The columns of the new unit are rolled steel, butt welded, 100 per cent plastic lines. Underdrain system consists of perforated stainless steel plate on top of which a plastic screen rests.

Regenerant piping includes non-cor-



rosive eductors, non-corrosive valves, and plastic draw-up lines for both acid and caustic regenerants. Process piping is 150 lb. bronze pipe for all raw water lines, stainless steel or plastic on all effluent lines.

70/Circle on Readers' Service Card

Universal Steam Trap

Perfecting Service Co., Dept. MF, 332 Atando Ave., Charlotte 6, N. C.

The Unitrap, a new, small lightweight bucket type steam trap for unit heaters, small processing machinery and like applications is available in ½″ pipe size, with a universal pressure range from 0 to 125 p.s.i. It was developed for low pressure-high condensate rate applications where a smaller and inexpensive trapping unit is needed.

The trap operates on a balanced

pressure principle through the unique function of its new and exclusive dual valve, which automatically compensates for differential pressures through a range of 0 to 250 p.s.i. The dual valve permits the traps to operate through fluctuating steam pressures and variable condensate rates within range of the traps without changing orifice size or bucket weights. Positive seating of the valve prevents wire draw and loss of steam. The line is competitively priced.

71/Circle on Readers' Service Card

Solution Agitator

Technic, Inc., Dept. MF, Providence 1, R. I.

Dispensing with stirrers, rod agitators and external pumps, the Turbomatic agitator effectively agitates precious metal electroplating solutions. The new device is reported to afford vigorous but smooth agitation which has not heretofore been available.

Model GTA-40 has a submerged positive displacement pump rated at 150 gallons per hour. As shown in the accompanying photo, it is designed for

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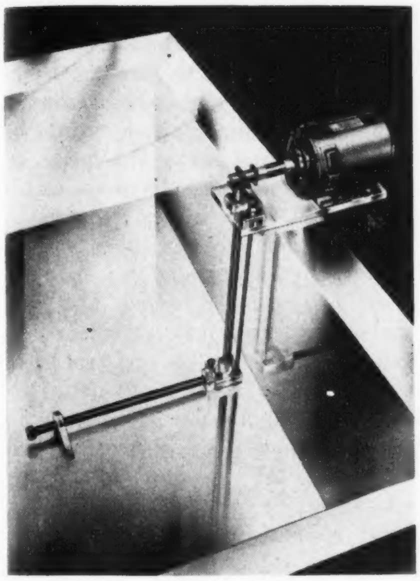


use in a tank 24" long and up to 24" in depth. Submerged parts of the agitator are constructed of Teflon, Bolteron, Lucite, and stainless steel. The complete unit is clamped to the side of the tank by an adjustable thumb screw, no other fastening being required.

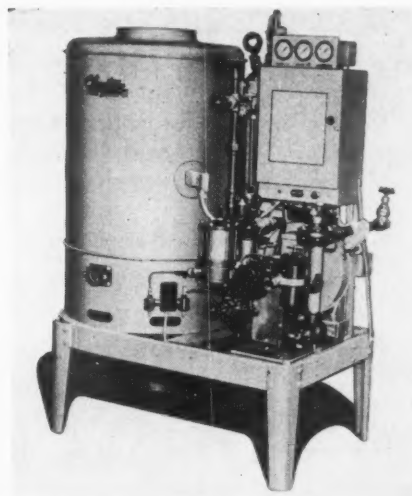
Power for the agitator is supplied by a $\frac{1}{8}$ horsepower 110-volt 60-cycle single-phase ball bearing motor. Totally enclosed, the motor is on a vibrationless rubber mounting.

73/Circle on Readers' Service Card

Steam Generator

Clayton Mfg. Co., Dept. MF, El Monte, Cal.

The above manufacturer's forced-circulation generator with balanced-feed design is now available in greatly increased horsepower rating. Formerly offering a normal rated boiler horsepower of 15, these models are now also obtainable with a 30 HP rating. Maximum horsepower has also doubled, from 16.5 to 33 HP.



Normal BTU output at 33,475 BTU per HP therefore becomes 1,004,250 in normal operation. Normal steam output is 1,035 pounds per hour. These steam generators are designed with a pressure of 200 pounds per square inch.

74/Circle on Readers' Service Card

Liquid Compound Applicator

Clair Mfg. Co., Inc., Dept. MF 1002 S. Union St., Olean, N. Y.

The new Series 3020 Spray Gun Mover for applying liquid polishing and buffing compounds is claimed to offer the following features:

1. May be equipped with either one or two spray guns. 2. Will accommodate either two or three-port guns. 3. Coverage is adjustable from 2" to 40". 4. Incorporates 110 volt electrically controlled compressed air actuation. 5. Straight line traverse is easily adjustable over an unlimited range of uniform speeds. 6. Adjustable for

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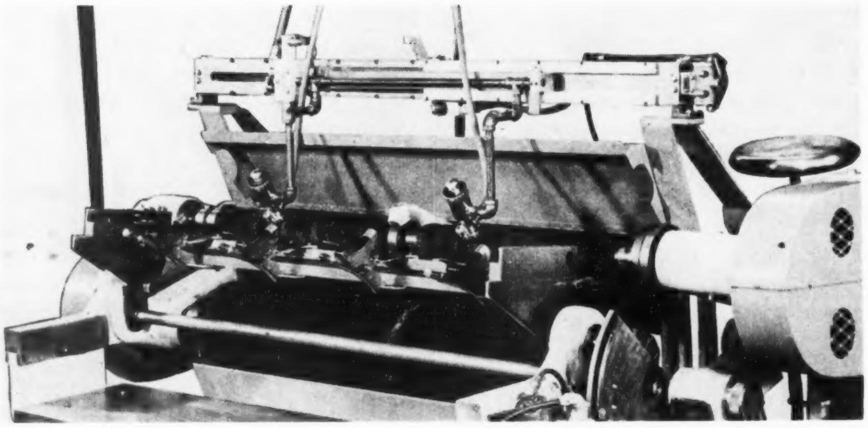


spray in either one only, or both directions of traverse. 7. Spray guns are serviced with clean, dry, oil-free air. 8. Overall length is only 51". 9. Total weight is but 43 pounds. 10. Simple four bolt foot mounting. 11. Operates equally well in any and all positions. 12. Absolute minimum of moving parts. 13. Sealed anti-friction bearings throughout. 14. Structure forms its own enclosure. 15. All actuating components are proven brand name items. 16. Control circuit permits operation with either foot contact microswitch or auto-cycling by means of timer or counter.

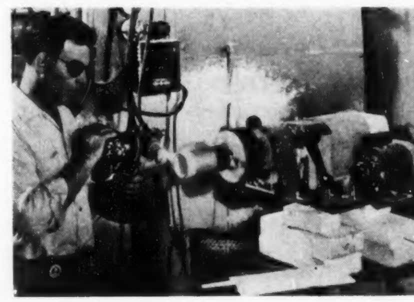
The device is also available on a custom basis in shorter over-all lengths wi.h proportionately shorter maximum coverages.

76/Circle on Readers' Service Card

Spray Gun for Refractory Coatings

Metallizing Co. of America, Dept. MF, 3520 W. Carroll Ave., Chicago 24, Ill.

The new line of oxide coatings, developed by the Norton Co. and known by the trade name Rokide, is being successfully applied to base metals and other materials by means of a specially designed metallizing gun, using the materials in rod form. This new oxy-acetylene gun reduces the rod to molten particles at temperatures in excess of 5,000°F. and projects them at high velocity by compressed air onto the metal surface to be coated. The metal surface is previously roughened by grit blasting and the resultant bond shows good adhesion. By its nature the coating is slightly porous in structure and in turn shows a surprising flexibility. One 24" standard rod of aluminum oxide 1/8" in diameter will cover approximately 20 or more sq.



in. .010" thick in six minutes. Experiments are continuing with larger sized rods which will afford about double that rate of application. Thickness of coating is usually between 5 and 50 mils, although coatings of 100 mils have been successfully applied.

Among the other unique features of the metallizing gun are its special rubber feed rolls which replaced the standard steel feed rolls owing to the rapid wear of the latter in feeding the extremely hard rods. Also, because the material is only available in rod form, generally in 24" lengths, a special friction device was developed for the extension unit to facilitate the continuous feeding of the rod lengths into the metallizing gun.

The gun is equipped with a pistol grip for manual spraying or can be tool post mounted. Small parts are usually sprayed in a continuous production line operation. For spraying of larger parts in intermittent operation, the feeding of the rod can be started and stopped without shutting down the gun.

78/Circle on Readers' Service Card

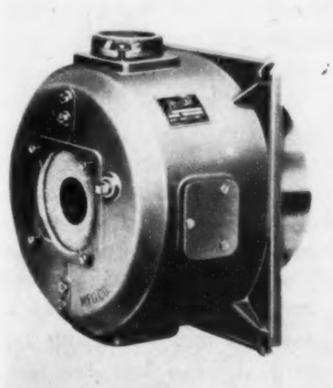
Blended Flame Unit for Gas or Oil Firing

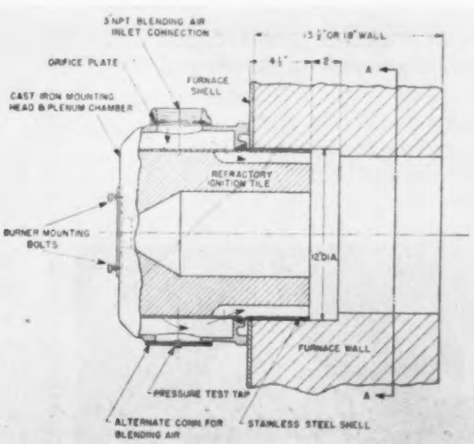
Hauck Mfg. Co., Dept. MF, 124-136 Tenth St., Brookyn 15, N. Y.

The above company has developed an effective means of utilizing excess air—up to 1000%—to insure complete fuel combustion and obtain better circulation of heat at temperatures of 400° to 1800° F. in industrial furnaces, ovens, kilns and other heat processing equipment, it is claimed.

The Blended Flame Unit consists of a cast iron mounting head and plenum chamber with inlet for blending air, burner mounting bolts, and a refractory ignition tile within a stainless steel shell. By diluting the high temperature combustion products by thoroughly blending them with excess air, these products are increased in volume, while their average temperature is reduced. Thus, with this expanded volume of gases, circulation and distribution of heat is improved, with greater uniformity of temperature throughout the heating chamber. Localized hot spots which occur in the use of relatively smaller volume of undiluted, high temperature products of combustion are avoided. Moreover, because of the wide range of temperatures which can be produced there is greater flexibility in the operation of the heating equipment, enabling its use for different kinds of work.

The unit is designed to assure a stable flame and prevent the entry of excess air from interfering with the



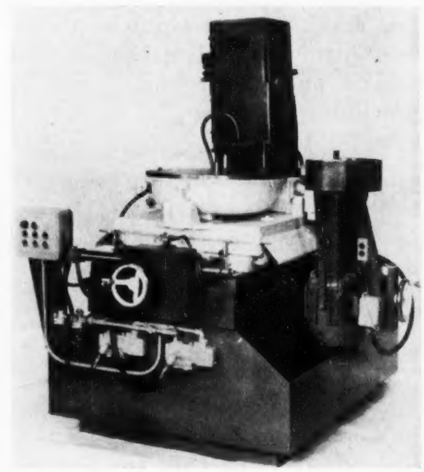


ignition and combustion of the fuel within the refractory tile. The excess air flow is outside of the tile, so that blending takes place only at the tile outlet and periphery of flame. The path of the excess air is as straight as possible in the blending stage. Thus, combustion goes to completion before complete blending takes place.

80/Circle on Readers' Service Card

Platen-Type Belt Polisher

Engelberg Huller Co., Dept. MF, 831 W. Fayette St., Syracuse 4, N. Y.



For high-speed precision finishing of outside diameters, a new automatic rotary abrasive belt grinder is designed to handle circular parts from 26 inches to 40 inches in diameter, and can be modified to meet other diameter ranges.

The self-contained motor-driven work table rotates at standard speeds of either ¾ or 3 revolutions per minute, with optional change gears for other r.p.m. requirements. An air-controlled infeed mechanism carries the rotating parts in against the belt, and infeed travel is adjustable with a minimum of .0016-inch per revolution.

To insure even distribution of belt wear, the parts are moved back and forth across the belt face by means of an air-hydraulic reciprocating device, with 7-inch oscilliation stroke. The table is adjustable from 0 to 45 degrees for angular grinding.

For applications requiring deburring, a tampico brush attachment is provided as an optional attchment. The brush is moved in against the belt-ground work by a manual control wheel, and can be swiveled to coincide with grinding angle of machine table.

Standard abrasive belt size is 8 x 107 inches, with belt speed available

from 2,000 to 5,000 s.f.p.m., depending on application. Capacity of coolant unit, equipped with ½ h.p. coolant pump, is 100 gallons.

This o.d. belt grinder is 70 inches long, 70 inches wide, and 76 inches high, and is powered by a 10 h.p. motor. Work table height is 47 inches. Approximate shipping weight is 4,700 pounds.

81/Circle on Readers' Service Card

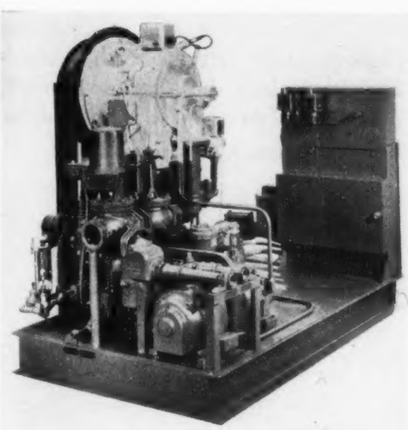
Packaged Combustion Assemblies

Orr & Sembower, Inc. Dept. MF, Reading, Penna.

Complete packaged combustion assemblies utilize gas, oil or combination gas-oil firing for modernizing or converting existing boiler or processing equipment or for obtaining efficient operation from new boiler or processing installations.

The fuel burning systems include burner, automatic controls, forced-draft air supply, full modulation firing control, ignition, complete piping and wiring and the refractory required for the burner throat. Complete flexibility of the unit permits use on furnaces, ovens, vats, kilns, dryers, boilers, and numerous other types of industrial heat exchangers.

Various combinations of assemblies are available to meet any installation



requirements without need for costly alteration. The burner comes as a complete unit. All components are assembled at the factory into a single fuel burning system, simplifying installation on existing or new equipment. Five sizes are available for maximum firing rates ranging from 3-million to 25-million BTU per hour.

The air-atomizing oil conversion burner features clean, efficient combustion and modulated firing over a wide range of loads. The burner is designed

to handle fuels ranging from light distillate through heavy Number 6 residual oil. Pre-heaters are an integral part of the heavy-oil assemblies. Manufactured, mixed, natural, bottled, or special gas fuels can be burned in the partial-pre-mixing design gas burner, which provides maximum flame stability and combustion efficiency. The oil/gas burner is a combination of the two, being immediately interchangeable from one fuel to the other.

83/Circle on Readers' Service Card

Electroformed Cavities

Camin Laboratories, Inc., 104-14 S. Fourth St., Brooklyn 11, N. Y.

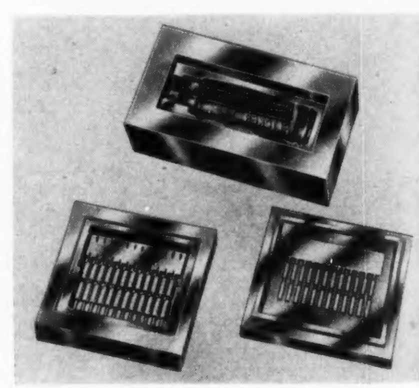
A new method for making highly precise intricate plastic mold cavities by electroforming is claimed to be ideal for exceedingly deep cavities, for cavities which must reproduce exacting surface designs and textures, and for a series of cavities which are identical. These cavities reproduce intricate shapes that can't be machined, can't be hobbed.

Among the many advantages claimed for this new method are:

1—Nickel does not rust or oxidize in any way—thereby eliminating the danger of damage to cavities during downtime of molds.

2—Nickel is not attacked by molding lubricants.

3—No polishing of any kind need be done to the interior of the cavities. They reproduce the finish of the hob. There is no porosity or other surface defects of any kind.

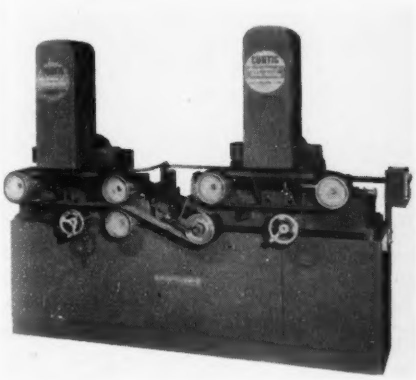


4—Electroforming lends itself ideally where hobbing or other methods are not able to perform—precision gear cavities, long, narrow shapes such as pen barrels, toys, eye droppers, small parts which might be too risky for hobbing, parts where great detail is required, parts with grained surfaces.

84/Circle on Readers' Service Card

Belt Polisher

Curtis Machine Corp., Dept. MF, Jamestown, N. Y.



Near automation, in the grinding, polishing and deburring field, is made available with the new Model 304C2 double side grinder. Incorporating a turn-over transfer unit between conveyorized abrasive belt heads this version of the firm's "Straight-O-Matic" machines will grind, polish or debur both sides of a work piece in one handling of the stock. The simple foolproof Turn-over mechanism is time tested and allows grinding and polishing of pieces of different sizes and shapes. It can be easily engineered to accommodate practically any piece.

The unit uses abrasive belts 4" wide x 54" long and incorporates a 1½ H.P. abrasive belt motor and two ¼ H.P. infinitely variable speed conveyor drives.

85/Circle on Readers' Service Card

Temperature Controller

Burling Instrument Co., Dept. MF, 16 River Road, Chatham, N. J.

A new series of differential expansion type temperature controllers, Models F-1C, F-2C, and F-3C, includes several new features and offers modifications which permit use in an unlimited number of applications.

These include accurate on-off temperature control of heating operations, processes, equipment, etc., safety alarms and cut-outs on similar installations, and combinations of control and alarm. The choice of one, two, or three snap-action switches on any instrument makes many unusual installations possible. Temperatures from sub-zero to 2000°F can be handled without difficulty; adjustable ranges as wide as 1200 degrees in one instrument are offered.

Operation is by the difference in ex-

86/Circle on Readers' Service Card

pansion of two concentric tubes when

exposed to heat. The resulting movement is multiplied through a lever arrangement which actuates one or more switches. Standard switch rating is 15 amp, 125-250v, AC, but higher ratings are available.

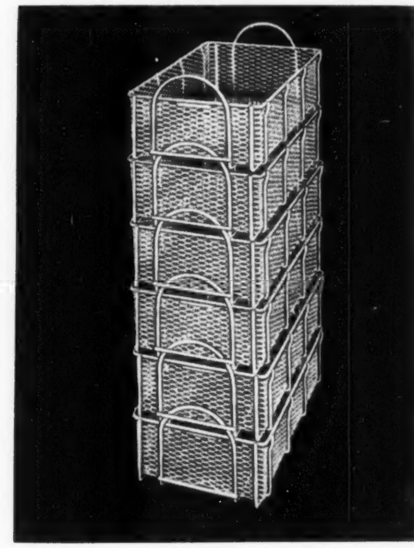
All cases are weathertight and may be used in outdoor locations. Temperature adjustments are all made externally, but two styles offer choice of knob with pointer for easy adjustment and socket head set screw where tampering must be discouraged.

Units are for local mounting and may be furnished with flanged or threaded fittings.

87/Circle on Readers' Service Card

Stacking Baskets

Wire & Iron Products, Inc., Dept. MF, 1721 Sixteenth St., Detroit 16, Mich.



A standard line of stacking baskets for bulk parts handling is now offered under the trade name of Eezy-Stak.

Fabricated of flat expanded metal (1/4" or 1/2" on welded steel wire frames, the baskets are open mesh construction for quick drainage and easy cleaning, and have a zinc-plated, rust-resistant finish. Patented interlock handle provides safe, convenient stacking and compact parts storage. Inside dimensions are 12" x 20" x 5-1/2". They are available from factory stock.

88/Circle on Readers' Service Card

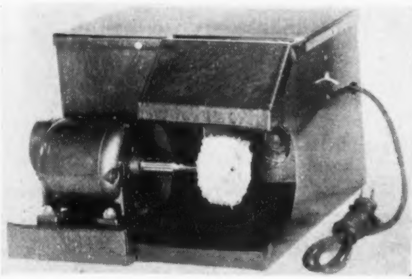
One-Spindle Polisher has Dust Collector

Vu-Al Products, Dept. MF, 424 South Broadway, Los Angeles 13, Cal.

Producers of small metal parts which require polishing are now offered an inexpensive polishing machine with the advantages of a dust-collector unit in the new one-spindle polisher. While the larger, two-spindle polishers may be required for heavy production work, especially where a variety of buffs and wheels must be used, the one-spindle polisher with dust collector is an efficient machine for steady use where few changes need be made in buffs and wheels.

Compact and made to fit on a bench or in any other small working space, the polisher measures 9" x 12" x 14". Operating on 120 volts, it has a sturdy, 3,450 RPM polishing motor and a

separate dust-collector motor. Suction takes in all polishing dust, keeping the work area dust-free; where precious metals are being polished it collects and saves the dust to be reclaimed. The dust collector's 6″ x 8″ spun glass filter is easily cleaned, and easily changed; replacement filters are inex-



pensive. A screen keeps tools and parts, dropped in polishing, from being drawn into the filter.

The polisher has an all-metal case with hammertone-gray lacquer finish. A strong light under the hood gives clear vision of work being done.

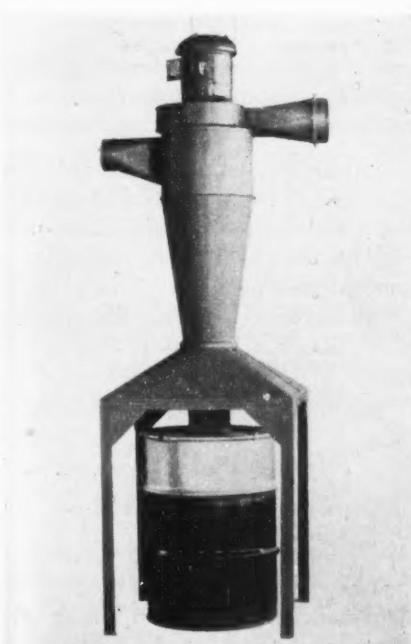
89/Circle on Readers' Service Card

Dust Collectors

Torit Mfg. Co., Dept. MF, 287 Walnut St., St. Paul 2, Minn.

A new line of cyclone-type dust collectors features connections to standard 55-gallon drums.

Known as the Series 55 collectors, their exhausting capacities range from 1,000 to 1,100 cubic feet of air per minute. The collectors feed directly into standard 55-gallon (or smaller) drums, which can be quickly removed and replaced when full.



91/Circle on Readers' Service Card

These collectors are easily installed, stand on a sturdy four-legged frame and have an airtight flexible shield that connects to the top of the drum. Everything is furnished except the drum. F.o.b. factory prices for the units range from $375 to $448.

Other specifications: height — 104″; width — 32″; depth — 32″; motor — 2 hp, 3,450 rpm; inlet diameter — 6″; outlet diameter — 8″; static pressure — 2.5″ to 2.7″ water; shipping weight — 440 lbs. to 510 lbs.

90/Circle on Readers' Service Card

Rubberized Abrasives

Cratex Mfg. Co., Dept. MF, 81 Natoma St., San Francisco 5, Cal.

A new polishing kit offers a wide use for every manufacturer to test the

above firm's rubberized abrasives on deburring, smoothing and polishing operations. The kit contains 24 of the most popular polishing wheels, cones, blocks and mandrels.

92/Circle on Readers' Service Card

Vibrating Parts Washer

Simplicity Engineering Co., Dept. MF, Durand, Mich.

A new vibrating parts washer is designed to clean machined parts of steel chips, filings, grinding dust, oil and grease quickly and economically with a minimum of handling.

The washer consists of a basket type agitator actuated by an oscillating assembly with two eccentric shafts, a gear driven flight conveyor to remove the parts from the washer as they are cleaned, a centrifugal pump and a filter with a re-cleanable cartridge. This unit uses only a ½ H.P. motor for the agitator and a dual shaft ½ H.P. motor to drive the flight conveyor and centrifugal pump.

The agitator rate of feed can be adjusted even while the machine is operating. The flight conveyor speed can be adjusted by a variable pitch pulley. The turbulent action of the agitator forces cleaning solution into all openings of the machine parts, yet with the parts being insulated by the washing solution and the agitator causing a "swimming" motion, there is no damage to delicate threads and flanges.

This new piece of equipment can also be used to degrease metal stampings and as a quencher for heat-treated machine parts.

94/Circle on Readers' Service Card

Conversion Coating for Zinc

The Chemical Corporation, Dept. MF, Springfield, Mass.

Luster-On 52 Powder is a new low priced single dip, no leach conversion coating for zinc plated surfaces, for automatic equipment where facilities are not available for added leaching and rinsing. It gives a bright bluish hue; provides corrosion protection against staining, tarnishing and white powder products.

The material can be used in cases where cost has prohibited use of chromates in the past. It is not only low in price, but eliminates expensive handling, space-consuming storage and carboy deposits.

95/Circle on Readers' Service Card

Manufacturers' Literature

Dry Pickling Salt

MacDermid, Inc.

Metex Acid Salt M-629, a new dry powder material, that replaces liquid muriatic and sulphuric acid, is fully described in Technical Data Sheet No. 43, a two-page usage and instruction sheet.

96/Circle on Readers' Service Card

Solution Agitator

Technic, Inc.

A new data sheet picturing the Turbomatic agitator, with specifications, is available from the above manufacturer.

Specifically designed for effectively agitating all precious metal electroplating solutions, the agitator does away with the need for stirrers, rod agitators and external pumps. It is reported to afford vigorous but smooth agitation which has not heretofore been available.

97/Circle on Readers' Service Card

Flexible Plastic Tubing

Plastics and Synthetics Div., The U. S. Stoneware Co.

A new manual, Tygon Flexible Plastic Tubing, Bulletin T-97, covers each of the many tubing formulations indi-

idually and in technical detail. Applications and limitations of each formulation are presented fully. Physical properties and chemical resistances based on A.S.T.M. testing methods are presented in chart and table form. Each chapter includes photographic illustrations of actual applications.

Included in the 28-page bulletin are chapters on: Laboratory tubing; Semi-rigid, general utility chemical hose; Flexible chemical hose; Flexible low temperature tubing; Vacuum tubing; Outer braid reinforced tubing for higher pressures; Cleaning methods; Special formulations, and fittings. Sixty-three bore and wall size combinations, available lengths and packaging data are presented in table form.

98/Circle on Readers' Service Card

Flexible Polyethylene Pipe

American Hard Rubber Co.

Ace Supplex flexible polyethylene plastic pipe and fittings are described in 8-page Bulletin CE-57. Contents of the bulletin include: applications for the pipe, sizes of standard pipe and fittings, installation instructions, technical properties, and estimated flow rates for water in various pipe sizes. Of particular interest to the industrial buyer is a chart which lists many common industrial liquids—acids, bases, organic chemicals, and so on — and specifies which of these liquids may be carried in the piping.

99/Circle on Readers' Service Card

Corrosion-Resistant Equipment

Haveg Industries, Inc.

A new design service being offered by the above manufacturer is described in a bulletin new available. The service covers corrosion-resistant heat exchangers, chlorine coolers, falling film absorbers, and towers of all types which can be built-up to any desired height. Covered in the bulletin are corrosion and thermal shock resistance, inherent strength, economy of use, and ease of fabrication of various plastics.

100/Circle on Readers' Service Card

Wet-Blast Equipment

The Cro-Plate Co., Inc.

A new 56-page fully illustrated spiral bound catalogue contains complete descriptive material on a line of manual, semi-automatic and fully automatic wet-blast equipment. Eighteen pages of the catalogue are devoted to well illustrated case histories covering a wide range of "Pressure Blast" wet-blast job applications. Also enclosed are illustrations of the various standard units available and full details on the type of abrasives employed in the process.

102/Circle on Readers' Service Card

Precision Metal Finishing

Summit Finishing Co.

To help keep those responsible for precision metal finishing abreast of modern techniques, developments in electroplating, and to put additional emphasis on the importance of accuracy, above company has published "Industrial Precision Electroplating," a library-size bulletin.

The bulletin, prepared in "Life" magazine style with twenty large photographs and short informative descriptions, begins by presenting the firm's organization including engineering and planning methods, service efficiency, laboratory, general production facilities, special production equipment, inspection, quality control, and pickup and delivery service. This is followed with an outline of the growth and advancements of metal finishing and Summit's contributions to the industry.

The metal finishing requirements of specific industries: electronics, electrical, aircraft, and bearing have been

given special attention in the bulletin, and a list of Federal specifications for which the company is approved is also included.

104/Circle on Readers' Service Card

Fused Bath Descaling

Kolene Corp.

A bulletin describing various adaptations of the Kolene system of descaling stainless, alloys and titanium after heat treating is now available.

105/Circle on Readers' Service Card

Wire Products

Cleveland Wire Cloth and Mfg. Co.

A new two-color illustrated folder, Bulletin No. 10, combines a brief history of the company with partial cataloging of the most popular wire screen items.

106/Circle on Readers' Service Card

Instrumentation Literature

Minneapolis - Honeywell Regulator Co., Industrial Div.

Bulletin G-2 is an index of Industrial Division literature. It covers catalogues. bulletins, specification sheets, data sheets, illustrated lectures and articles from Instrumentation Magazine.

107/Circle on Readers' Service Card

Pneumatic Controllers

The Bristol Co.

This new 56-page two-color bulletin, A130, is illustrated by more than 75 photos and drawings, describing the new high sensitivity, wide control-band Series 500W pneumatic controllers for temperature, pressure, flow, vacuum, etc.

Sections describing control principles, and illustrating the various control modes available are included.

108/Circle on Readers' Service Card

Organic Chemicals

Carbide and Carbon Chemicals Co.

More than 335 organic chemicals are described in a new 24-page booklet, F-6136. Condensed data on applications are presented and physical properties are given in tabular form. An alphabetical index is included for the convenience of the user.

The 1957 edition of "Physical Properties of Carbide and Carbon Chemicals" features twenty-one new products. For easy reference, chemicals are arranged by family groups.

109/Circle on Readers' Service Card

Industrial Cleaning Compounds and Solvents

Brulin & Co., Inc.

A new 8-page bulletin discusses the firm's complete line of industrial cleaning compounds and solvents. Illustrated with photographs, this bulletin gives detailed information and applications of chemicals for every industrial cleaning requirement. Ranging through the various cleaners and degreaser are a liquid steam charge for light and medium-duty steam cleaning where speed and safety are required; an emulsifiable liquid concentrate for cleaning and degreasing all metal and concrete surfaces; solvent for cleaning rust, scale and corrosion from aluminum, stainless steel and most other metals; and a specialized liquid cleaner designed to solve the most difficult cleaning of corrosion, pit marks and oxidation from aluminum.

110/Circle on Readers' Service Card

Handling & Storage Equipment

Randolph Industrial Equip. Co.

A complete new line of low-cost all-steel parts handling and storage equipment, comprising the RAN/dolph system, is described and illustrated in a new 8-page colorful catalog.

Specifications and uses for all models of stacking containers, expanded metal baskets, nesting pans and special sized steel tote boxes, plus racks, and movable steel pallet bases, are given in the

catalog. Complete price sheets and technical data are enclosed with all ordering information.

111/Circle on Readers' Service Card

Packaged Automatic Boilers

Orr & Sembower, Inc.

A new, four-page, illustrated bulletin, describes Power-Pak packaged automatic boilers for steam or hot water heating and hot water service.

This two-color bulletin provides detailed illustrations of both oil and gas-fired units, indicating front and rear views. Bulletin No. 1233 lists features and advantages, and tabulates dimensions, weights, and ratings for the various models in the line.

112/Circle on Readers' Service Card

Temperature Controls

Fenwal, Inc.

New 6-page catalog, MC-135, describes the complete line of Thermoswitch temperature controls. The literature gives physical specifications, performance data, temperature ranges and other pertinent information about these precision thermostats. Also listed and described are the various modifications and special features, such as moisture-proof seals, armored cable, extended shell, temperature - setting knob and dial, etc., which can be supplied to adapt the device to varied service requirements.

113/Circle on Readers' Service Card

Bulb-and-Capillary Temperature Controllers

Fenwal, Inc.

A well-illustrated brochure gives complete specifications on a new series of bulb-and-capillary indicating temperature controllers.

The brochure, MC-139, describes how the user can tailor a controller to his specific operating requirements by selecting from the proper "building blocks." Also illustrated is the design of the temperature sensing response mechanism.

114/Circle on Readers' Service Card

Conveyor-Type Belt Grinders

Engelberg Huller Co., Inc.

This 4-page bulletin describes various models of new multiple-head abrasive belt grinders. Included in the two-color bulletin are photographs, with complete specifications, of one-, two-, four-, and five-head models; two-side model for high speed surfacing of both sides of flat parts; production and operational photos; and illustrations of processed parts, with data on abrasive belts, tolerances, and production rates.

116/Circle on Readers' Service Card

BUSINESS ITEMS

Allied Research Appoints Merz

Allied Research Sales Corp., marketing subsidiary of *Allied Research Products, Inc.*, manufacturers of chromate conversion coatings and plating chemicals, has announced the appointment of *George H. Merz* as sales engineer. Mr. Merz will handle the Eastern Ohio-Western Pennsylvania territory from headquarters in the Bulkley Building, Cleveland 15, Ohio.

Mr. Merz has a long background of experience in the metal finishing industry. Prior to his new association, he was an independent consultant in the field and before that built a long record of sales-service work with the Harshaw Chemical Co.

Woolley Named Corrosion Engineering Specialist for Pennsalt

Douglas F. Woolley, Jr. has been promoted to sales engineer of *Pennsyl-*

vania Salt Mfg. Co.'s Corrosion Engineering Department. In this capacity he will specialize in assistance on corrosion problems in fields where application of the firm's line of corrosion resistant coatings, linings, interliners, and acid proof cement mortars are recommended.

Woolley is a graduate of Johns Hopkins University and has been with Pennsalt since 1952. He was a member of the technical service department prior to his present assignment.

Martin Aaron Joins Sam Tour & Co.

Martin Aaron, materials engineer and executive in the plastics and chemicals fields, has been appointed assistant to the president of *Sam Tour & Co., Inc.* and its affiliate the *American Standards Testing Bureau, Inc.* He will be in charge of customer relations and product certification programs of the latter company.

Mr. Aaron was previously vice-president of American Plastics Corp. and manager of technical procurement for Heyden Chemical Corp. In World War II, he was materials engineer at U. S. Army Cherokee Ordnance Works and later was engaged in Defense Plants Penicillin Production Program.

Before the war, Mr. Aaron was in charge of production for A. G. Laboratories of Brooklyn, New York, electromechanical and electrochemical specialty manufacturers.

Mr. Aaron attended University of Wisconsin, New York University and Brooklyn College.

Rheinhold Appointed V.P. of Richardson-Allen Corp.

John J. Rheinhold

Richardson-Allen Corp., College Point, L. I., announces the appointment of *John J. Rheinhold,* chief engineer, to the position of vice-president. Mr. Rheinhold is now active in the development of control systems using magnetic amplifiers for DC power supplies.

Mr. Rheinhold has become recognized as an authority on magnetic amplifiers; selenium, germanium and silicon rectifiers and has done an outstanding amount of research and developmental work in this field.

During the war years, he was an instructor in advanced radio technology with the Air Force. He was educated at Pratt Institute and Brooklyn Polytechnical Institute.

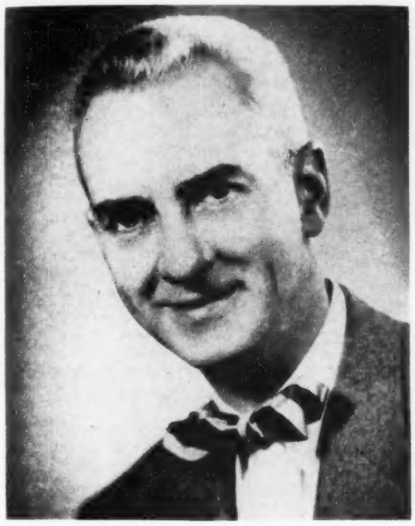
H-VW-M Names Davis Salesman in L. A.

Hanson - Van Winkle - Munning Co. has announced the appointment of *Russell E. Davis* as a sales representative for the company in the Los Angeles, Calif., area.

With twenty-five years of sales and engineering experience, Mr. Davis will represent the company in the sale of metal finishing equipment, supplies and processes. He will work under the general direction of *Harold R. Smallman,* district manager of the Los Angeles office and an assistant vice-president of the company.

Mr. Davis was self-employed as a

mechanical contractor from 1931 to 1937, then joined Hussman Refrigerator Co. of St. Louis. He served with this company from 1937 to 1946 as a field representative, then as the company's chief development and test en-



Russell E. Davis

gineer. In this latter capacity he was responsible for new product design, material testing, product and process testing.

He became a manufacturers' representative in 1948, selling heat transfer equipment for industrial and metal finishing process applications in the St. Louis area. Companies he represented at this time included Dean Products Inc. (N. Y.), manufacturers of heat exchange equipment, and Hudson Bay Co. (Chicago), manufacturers of environmental control equipment. Mr. Davis continued this work when he moved to Los Angeles in 1954.

He is a graduate of St. Louis University School of Commerce and Finance, where he received his degree in Business Administration. He also studied mechanical, industrial and electrical engineering at Washington University, St. Louis. He is a Registered Professional Engineer in Missouri (1946).

Blaw-Knox Ruthner Process for Disposing of Waste Acid Shown at Niles, Ohio

The nation's first pilot plant for disposing of steelplant waste acid by the Blaw-Knox Ruthner process was unveiled at Niles, Ohio on Sept. 17. Witnessing the startup of the experimental unit were leading water authorities from an eight state area.

The operation converts spent sulphate liquors into useful sulphuric acid and iron oxide. It is hoped this process will point the way to a solution of the problem of disposal of waste pickle liquor from the steel mills.

The new process represents the steel industry's latest approach to a problem which has stubbornly resisted years of scientific study and research. It was conceived by *Othmar Ruthner*, an Austrian scientist shortly after World War II. A three-year program of extensive development was carried out to adapt the process to American standards and to determine the proper materials of construction.

The half-million dollar pilot plant is sponsored by *Blaw-Knox Co., Jones & Laughlin Steel Corp., National Steel Corp., Pittsburgh Steel Co., Republic Steel Corp., United States Steel Corp., Wheeling Steel Corp.*, and *Youngstown Sheet & Tube Co.*

Construction started in April of this year. The unit will undergo extensive testing, first with water then with acids, for evaluating purposes. Located at Republic's Niles Works, the plant will utilize test quantities of waste pickle liquor.

Clabaugh Promoted to Head Cowles Metal Cleaner Sales

Carl C. Clabaugh is the new manager of the metal cleaner department for *Cowles Chemical Co.*, of Cleveland, Ohio. He will have full charge of the sale of alkaline metal cleaners, zinc

Carl C. Claybaugh

phosphate metal coatings, anti- corrode oils, and related items.

Clabaugh had been metal cleaner sales manager since June 1954, after serving for about a year as assistant manager. He started with the company as a metal cleaner salesman in Philadelphia late in 1951.

Previously, Clabaugh had been associated with a manufacturer and supplier of platers' supplies, working in Cleveland and in Cincinnati. He studied chemical engineering at Michigan State University — interrupting his studies to serve in the Air Corps in Italy and Africa during World War II.

Vanton Pump Opens Sales Offices in St. Louis

Vanton Pump & Equip. Corp., Hillside, N. J., a division of Cooper Alloy Corp., has announced the opening of a sales office in St. Louis, Mo.

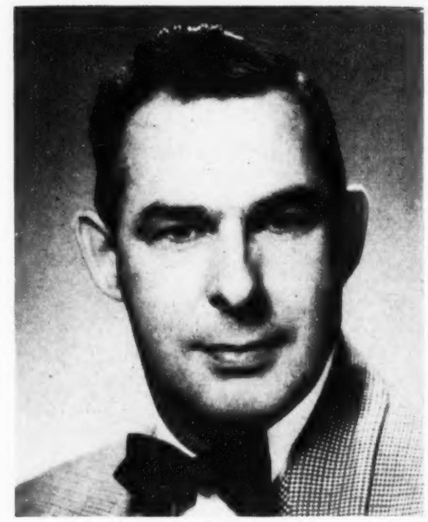
The office, headed by *E. H. Bigden*, will sell and service the company's pumps, plastic pipe, plastic valves and fittings, and stainless steel fittings, in Eastern Missouri and parts of Southern Illinois.

Logo, Inc., Promotes Meyer

Logo, Inc., announces the promotion of *Walter H. Meyer* to manager of sales of the *Vacuum Plating Division*. Mr. Meyer will supervise the field development and sale of the firm's vacuum metallizing finishes.

Michigan Chrome & Chemical Co. Announces Personnel Changes

Michigan Chrome & Chemical Co., Detroit, Mich., anounces the transfer of *Donald G. Patterson* to its Chicago



Donald G. Patterson

territory. Patterson will be responsible for sales and service in Northern Illinois and Indiana, Wisconsin and Minnesota. He has had several years experience in working with company customers in the electroplating and plastisol coating industries.

Ted Root takes over the Michigan territory. Root has been working in the firm's laboratory developing applications for their coatings. Prior to joining the company, Root attended

Ted Root

the University of Michigan and Wayne State University and had considerable experience in the transportation industry.

Dennis Chemical Appoints New Eastern Manager

Dennis Chemical Co., St. Louis manufacturers of plastisols, specialty coatings and adhesives, has announced the appointment of *G. J. Crowdes* as district manager in charge of the company's Ohio regional office. Mr. Crowdes was formerly with the B. F. Goodrich Co.

The office located at 2475 State Road, Cuyahoga Falls, Ohio, will service the Eastern area which includes Ohio, Pennsylvania, New York and Michigan.

Friedel Joins U. S. Stoneware Co.

Howard H. Friedel, recently appointed sales engineer to the *Process Equipment Div., U. S. Stoneware Co.*, Akron, Ohio, brings a wealth of experience to his new post.

After receiving his B.S. in Chemical Engineering from Case Institute of Technology in 1940 he entered into research and development of organic chemicals for Hooker Electrochemical Co. at Niagara Falls, N. Y. During World War II he worked on the government magnesium program at the Painesville, Ohio plant of Diamond Alkali.

Since the war Mr. Friedel has been in the sales field specializing in chemi-

Howard H. Friedel

cal processing equipment for the chemical and metal finishing industries. He is a registered professional engineer in the State of Ohio and is a member of A. I. Ch. E. and N.A.C.E.

Tilton Appointed by National Rack Co.

National Rack Co., of Paterson,

Herb Tilton

N. J., announces the appointment of *Herb Tilton* to their sales staff. Mr. Tilton's background includes 10 years of electroplating experience as manager of his own company. Prior to that, he studied electroplating technology at Hunter College, New York.

Mr. Tilton will be Naraco's engineering consultant on their complete line of plating racks, throughout the entire Eastern United States.

Sel-Rex Precious Metals Appoints Fischer New England Representative

Emil Fischer, formerly director of *Seymour Mfg. Co.'s* Bright Nickel Department, has been appointed resident

Emil Fischer

New England sales engineer, for *Sel-Rex Precious Metals, Inc.*, Belleville, N. J.

A technical man in every sense of the word, Fischer spent over ten years with Seymour in various technical and administrative positions, prior to being named director of their Bright Nickel Department. His experience also includes several years with Farrel-Birmingham (Ansonia, Conn. steel and iron foundry) as a technician.

Appointed primarily to service precious metals accounts in the area, Fischer will also represent rectifiers and filters manufactured by *Bart-Messing Corp.*, an associaetd company.

Kelite Forms New Regional Sales Organization

The formation of a new regional sales organization has been announced by *Kelite Corp.* The United States is now divided into four sales regions: Western, Southern, Midwestern and Eastern. These four regions will be headed by regional sales managers; *R. J. Racine* at Los Angeles; *A. F. Rotoli* at Dallas; *A. W. Lupien* at Chicago; and *W. L. Hennessy* at Jenkintown, Pa.

This new organization will provide the firm's principal marketing areas with integrated office, technical service, laboratory, and other facilities.

Frederic B. Stevens, Inc. Appoints Distributor

Frederic B. Stevens, Inc., Detroit 16, Mich., announces the appointment of the *R. F. McGuire Co., Inc.*, 106 East Melvina St., Milwaukee 12, Wis., as exclusive distributors for their metal

R. F. McGuire

finishing equipment and supply line in the state of Wisconsin, effective September 1, 1956.

The McGuire company is a new corporation headed by *R. F. McGuire*, formerly technical director and sales engineer for Donald Sales and Mfg. Co., Milwaukee, Wis. Mr. McGuire was with the Donald organization for twenty years prior to organizing the new firm. Prior to that time, he was associated with The Udylite Corp. and United Chromium, Inc.

American Chemical Paint Acquires Benjamin Foster Co.

Acquisition of all outstanding capital stock of the *Benjamin Foster Co.*, Philadelphia, Pa., by the *American Chemical Paint Co.*, Ambler, Pa., was announced recently.

Foster and its subsidiary, Benjamin Foster Co. of Canada, will operate as wholly owned subsidiaries. No personnel changes are planned.

American Chemical Paint Co. produces metal working chemicals, and Foster specializes in industrial coatings and adhesives.

Morton Gilbert New Stokes Specialist

Morton B. Gilbert has been promoted to the headquarters staff of the *High-Vacuum Equipment Division* of *F. J. Stokes Corp.*, Philadelphia, Pa., as a product specialist in charge of sales and product development for batch vacuum metallizing equipment.

Born in Lynn, Mass., and educated in the public schools of Haverhill, Mr. Gilbert was graduated from the University of Massachusetts in 1949 with a B.S. in Chemistry. For the next year he did graduate work at Kansas University, where he held a teaching fellowship.

Mr. Gilbert then switched to sales work, spending the next four years with the Boston branch of the Central Scientific Co., and the following year with Consolidated Vacuum Corp. in Rochester, N. Y. He joined Stokes a year ago and has been a sales engineer in the Chicago district.

Dean H. Snelgrove Joins Wyandotte

Dean H. Snelgrove has been appointed industrial sales representative of *Wyandotte Chemicals Corp., J. B. Ford Division* covering the Southwestern Michigan area. He will headquarter in Battle Creek.

Dean H. Snelgrove

Mr. Snelgrove received his chemical education at the Detroit Institute of Technology. He served three years with the U. S. Navy and has been doing sales-service work for the past 8 years.

Since joining the company, Mr. Snelgrove has been given intensive training in both the research and technical service laboratories. In addition, he has received practical field training in every industry he will service.

Maytag Co. Promotes Stoulil

The promotion of *Robert Stoulil* to superintendent of the plating department has been announced by the *Maytag Co.* of Newton, Iowa.

Stoulil started work in the plating department in 1945 and was made a foreman in 1951. He became general foreman of the department in November, 1955. A veteran of the Marine Corps, he is married to the former *Nadene Sultice* of Newton.

Torit Names Schuerer as Wisconsin Representative

Edward V. Schuerer

Edward V. Schuerer has been named district representative in the state of Wisconsin and the upper peninsula of Michigan for *Torit Mfg. Co.*, St. Paul.

Schuerer has been a manufacturer's agent since 1950 and presently represents Everede Tool Co., Cadillac Stamp Co., Nelco Tool Co., and A. L. Dery Tool & Die Co., in addition to the Torit line. He headquarters at 2625 N. 111th St., Wauwatosa.

Acoustica Names Church

Acoustica Associates, Inc., Glenwood Landing, N. Y., has announced the appointment of *Donald R. Church* as chief engineer.

Mr. Church (B.S. in Mining Engineering, Univ. of Minn., and graduate studies in Electrical Engineering, Univ. of Maryland 1947-1954) formerly was a staff member of the Ultrasonic Development Group of the Naval Ordnance Laboratory, Silver Springs, Md. and other leading research organizations.

It was also announced that the company will double its staff and quadruple its floor space by the end of 1956 in order to accommodate an increasing number of orders for the firm's large-scale ultrasonic cleaning systems.

Pangborn Licenses Leading English Firm

Pangborn Corp., Hagerstown, Md., manufacturers of airless blast cleaning and dry and wet dust control equipment, announce they have just signed an exclusive licensing agreement with *Hepburn Conveyor Co., Ltd.*, of Wake-

field, England, for sole manufacturing and sales rights of Pangborn equipment in the following countries: England, Scotland, Wales, Ireland, Australia, New Zealand and Union of South Africa.

Pennsalt Expands Chicago Heights Specialties Plant

Pennsalt Chemicals is nearly doubling the size of its plant at Chicago Heights, Ill., a unit of its *Chemical Specialties Division*. Constructed 18 months ago, the plant is a blending, packaging and warehousing facility for the firm's specialty products. The new wing, scheduled for completion in October, will be used for offices, a small control laboratory and additional warehouse space.

Bart-Messing Promotes Mazza to Manager of Manufacturing

The promotion of *John R. Mazza* to manager of manufacturing, has been announced by *Bart-Messing Corp.*, Belleville, N. J.

Mazza joined the company in 1950 as assistant chief engineer, and was advanced to chief engineer in July of 1955. An Electrical Engineering graduate of Pratt Institute, and a Power Option Specialist, Mazza is credited with having contributed materially to the design of the firm's rectifiers incorporating many innovations of circuitry and automatic, remote controls.

John R. Mazza

Mazza, whose headquarters will be at 155 Manchester Place, Newark 4, N. J., was formerly associated with the Richardson-Allen Corp., rectifier manufacturers, as an electrical engineer in charge of testing and field installations.

Stevens Transfers Brown to Buffalo Office

Frederic B. Stevens, Inc., Detroit 16, Mich., has announced the appointment of *Roger J. Brown* as metal finishing sales engineer for the western New York district effective August 1, 1956. Brown will operate from the Buffalo office and handle the company's metal finishing accounts in western New York and sections of northwestern Pennsylvania.

Prior to his appointment to the Buffalo office, Brown was employed for nine years in the Sales Department of the Detroit office serving in the combined capacity of production control and coordinator of sales, engineering and manufacturing operations of all manufactured equipment. His intimate association with all engineering and operational phases of plating equipment and service problems makes him extraordinarily well equipped to service any plating room problem.

Prior to joining Stevens, Brown was employed by Long M'f'g. Div., Borg Warner Corp., and served with the Army Air Force in the Pacific during World War II.

Mr. Brown attended the College of

Commerce and Finance at the University of Detroit and is a member of the Detroit Chapter, American Electroplaters' Society.

American Buff Co. Marks 21st Year with Party, Gifts for Employees

Employees of the *American Buff Co.*, Chicago, were honored at a special luncheon party on Friday, September 14, celebrating the company's 21st anniversary.

Ben P. Sax, president, tendered a "President's Progress Report" outlining the company's growth and achievements in its 21 years. At the conclusion of the luncheon, Mr. Sax presented each employee with a canvas money bag containing twenty-one silver dollars.

PATENTS

(*Continued from page 75*)

Gas Plating

U. S. Patent 2,742,691. *Apr.* 24, 1956. *H. G. Belitz and O. F. Davis, assignors to Commonwealth Engineering Co. of Ohio.*

A method of working and coating cast steel billets prior to rolling and which yields upon rolling a clad steel having a thin uniform thickness surface layer of corrosion-resistant metal material, said method comprising the steps of (a) casting a steel billet at a temperature in the range of approximately 1900 to 2500°F., (b) lowering the temperature of the cast billet to between about 350-450°F. while retained in a non-oxidizing atmosphere, (c) subjecting the resultant temperatured billet to gaseous metal plating by contacting the hot billet with a gaseous mixture containing a corrosion-resistant gaseous metal compound which decomposes depositing corrosion-resistant metal onto the surface of said cast steel billet to provide the same with a relatively thick metal coating of approximately 0.10 inch in thickness, (d) heating the resultant metal plated billet to a temperature between about 1,300-2,500°F., and (e) hot working the thus heated billet by passing the same through a roughing and finishing train of rollers to produce a clad steel sheet having a relatively thin protective metal coating which is on the order of 0.0005 inch in thickness.

Corrosion Preventive

U. S. Patent 2,743,202. *Apr.* 24, 1956. *G. Amici.*

An antioxidizing composition for protecting metal articles against rust or other kinds of oxidation, comprising two saturated hydrocarbons selected from the group consisting of liquid paraffin, gasoline and petroleum oil, and a liquid hydrocarbon comprising a pinene capable of readily absorbing oxygen to become first oxidized and then act as an oxidizing agent to produce a protecting oxide on the metal surface, said saturated hydrocarbons constituting from about 70% to 85% by volume, of the composition and being present in sufficient quantity to retard the evaporation of the a-pinenes for a sufficient period to enable them to accomplish both the aforesaid

actions, and said liquid hydrocarbon consisting essentially of a-pinene and constituting from about 15% to 25%, by volume, of the composition and being present in sufficient amount to produce a protecting oxide on the metal surface and to render, in this way, the composition capable of protecting the metal to which it is applied against further oxidation.

Electroplating Pipe Joint

U. S. Patent 2,745,797. May 15, 1956. G. R. Long, assignor to General Motors Corp.

The method of coating a joint between sections of copper and aluminum which comprises immersion depositing cadmium on the aluminum adjacent said joint and then electroplating said immersion deposit and the copper adjacent said joint.

NEW BOOK

Metal Industry Handbook & Directory

Published by Iliffe & Sons, Ltd., Dorset House, Stamford St., London, S.E. 1, England. 1956. Price: 16s. 3d. postpaid. Paper cover. 494 pages, including directory.

The 45th yearly edition of this well-known handbook is slightly larger than its predecessor and, as usual, the subjects of electroplating and allied processes take up only about ten per cent of the volume. However, the data on the general properties of metals and alloys and the general tables are just as valuable as they ever have been. The directory section is unusually comprehensive but would be of interest mainly to European finishers. The book is available free to subscribers of the weekly journal, *Metal Industry*.

Associations and Societies

AMERICAN ELECTROPLATERS' SOCIETY

Newark Branch

The September 21st meeting of the Newark Branch was called to order by President *Clifford Struyk* following a movie presentation by *Howard Cobb* with 95 members in attendance. Secretary Foulke announced that the Branch now has 301 members and presented three applications for action. *William Grigat*, chairman of the Christmas Party Committee reported that real progress was being made and, as chairman of the Membership Committee, noted that every member was a member of this committee and announced that *Seymour Longai* would serve as co-chairman.

The meeting was then turned over to Librarian *Dodd Carr* who introduced *Cy LaManna* of Bart Laboratories, Inc., to present the timely topic "The Chemists' Role in Electroplating." He pointed out the need for regular analyses and record keeping, the chemists' function with respect to improving processes and developing new ones as well as the inadvisability of the chemist performing routine tests. The various methods of analysis, plating tests, and physical property measurements were discussed in the light of their importance to plating industry.

Dr. A. M. Max of the Radio Corporation of America then presented the principle paper of the evening, "The Contribution of Electroplating to High-Fidelity Records." The job of the plates is to reproduce accurately the recording and this is being done now much as at the start of the industry. The improvements have been primarily the result of much more control of the

plating process. Impurities are controlled by continuous purification.

Stress is also carefully controlled. One of the important results of the improved control has been the elimination of the older polishing step which is undesirable for high-fidelity records. After a question-and-answer period of some length, the meeting was adjourned and refreshments enjoyed.

D. Gardner Foulke
Secretary

Pittsburgh Branch

The initial meeting of the '56-'57 season was held September 5 at the Gateway Plaza. The Housing Committee has selected the Gateway Plaza for the meeting place this year after having many favorable comments on the closing meeting in May, which was also held there.

After a fine steak dinner at 6:30, the business meeting was opened by President *M. Ceresa.* Following roll call of officers, four new members were welcomed by the Branch. They were: *Richard P. Cope, Jr., Joseph E. Kessler, Edward L. Kost,* and *William M. Lorkovic.* The transfer into the Branch of *Rafael Diaz* from Twin Cities Branch was also announced. Two applications for membership were read for the first time. These gentlemen were: *Jacques G. Lussier* and *Edward B. Keller.*

The financial report was given by Treasurer *W. Pizoli.* A short discussion was held on the possibility of investing $500 in a savings account rather than leaving all excess capital lie idle. The Executive Committee was instructed to investigate further and report at the next meeting. Delinquent members were also urged to pay their dues immediately.

The guest speaker, *Dr. W. G. Sink* was introduced by Librarian *R. Woehrle.* Dr. Sink of Fisher Scientific Co. discussed "Laboratory Instrumentation for Electroplaters." He touched on many instruments which he feels will become very useful to the plater in the control of plating solutions and waste waters.

After a short stretch, Dr. Sink drew the name for the door prize. The winner was *C. McHattie* and the prize, a set of kitchen utensils, was donated by *C. Benson* of Behr-Manning Co. The door prize is a special feature of each meeting and is presented by one of the generous suppliers of the area. The meeting was then adjourned.

Fred Stevens
Secretary

Chicago Branch

The first meeting of the fall and winter season of the Chicago Branch was held at the Western Society of Engineers Friday, September 14. After an interesting business meeting and dinner a most informative educational session on the subject of the operation of bright copper solutions was conducted.

Because the subject is of such wide spread interest the Chicago Electroplaters' Institute members were guests of the Chicago Chapter.

The speaker of the evening was *E. H. McCoy* of Electrochemical Products Co., Milwaukee, Wis. Mr. McCoy is well known to many of the Chicago Branch members, having been a very active member in the branch before moving to Wisconsin.

In the early part of the discussion Mr. McCoy invited the group to inter-

rupt him at any time with questions. As a result, the session covering the operation of acid, phosphate, and cyanide copper plating solutions was held on a class room basis, with many questions asked and answered. Mr. McCoy is to be congratulated for the fine way in which the subject was presented and discussed.

Joseph Corre
Publicity Chairman

Saginaw Valley Branch

On September 12, 1956 the first meeting of the 1956-1957 season of the Saginaw Valley Branch was held in the Colonial Room at Zehnder's Hotel in Frankenmuth, Mich. Chicken dinners, the specialty of Frankenmuth, were served and enjoyed by 53 hungry electroplaters.

A short business meeting followed during which two new members were voted in. The two principal speakers were *King Ruhley* of the Michigan Chrome Co. and *Duane Faulman* of the Imperial Rack Co. Mr. Ruhley talked about the latest development in rack coatings. Mr. Faulman discussed rack fundamentals and design and introduced the new "do it yourself" kits for assembling racks to fit parts for anodizing.

After the very informative talks, slides were shown of the July Stag Day Party.

Charles Melekian
Recording Secretary

Indianapolis Branch

The Indianapolis Branch opened its 1956-57 season with a dinner at Fox Steak House with thirty-four members present. The order of business included introductions, reports of the secretary and treasurer, and final report of the annual educational session and dinner dance.

In the absence of *Fritz Anderson*, senior member of the Tri-State organization, *Les Reynolds*, junior member gave a detailed report of the plans for the March 30, 1957 meeting at French Lick Springs Hotel. All committees have been appointed and they are as follows:—

Reservations and arrangements — *Les Reynolds.*

Publicity—*Edna Rohrabaugh.*

Entertainment—*Quentin Shockley.*

Tickets—*Bert Hawhee* and *Frank Hartwig.*

Printing-Advertising—*Roman Bender.*

Men's activities—*Vince Kelly.*

Favors—*Les Reynolds* and *Edna Rohrabaugh.*

At the national convention in Washington, D. C., a custodian of the funds for the Tri-State was appointed and this will be *Edna Rohrabaugh* of the Indianapolis Branch. Reports were given on the national convention and *John Holland* gave a report on the business sessions and also about some of the more interesting things that happened.

Last spring the president asked *Ed Bruck* along with *Al Kriese* to write up the branch history and at this time, Mr. Bruck presented it. It was most explanatory and interesting and a copy is spread upon the minutes for further use. The branch extended a hearty vote of thanks to Mr. Bruck and Mr. Kriese for their work.

Dr. Abe Max reported on the plating school to begin September 27th at the Purdue U. Extension Center. About sixty applications have been received

133/Circle on Readers' Service Card

134/Circle on Readers' Service Card

and as there is room for about 28, the course will be repeated at a later date if necessary.

Under new business the following were transferred to the branch:—

J. A. Hendricks from Cleveland.
Thomas F. Stapleton from Detroit.
George S. Johnson from Dayton.

As the present secretary wishes to be relieved of the job, a new secretary was chosen by unanimous vote of the branch. He is *Paul B. Freeman*. This was done in a motion by *Herb Kennedy* and seconded by *Quentin Shockley*. A rising vote of thanks was given to Miss Rohrabaugh for her work for the last four years.

The October meeting of the branch will be at Columbus, Ind. and *Tom Evans* gave information that it would be on the regular night of October 3rd with dinner in the Arvin Cafeteria and an excellent program to follow. This is to be guest night and all members are asked to be present and bring their wives or friends.

The paper to be written by the branch members is under way and *Dave Sivertsen* accepted chairmanship of the committee. He will report at a later meeting the early results.

The program for the evening was given by Dr. Max on "Iron Electro-Forming." This was the same as presented at the national convention and proved very interesting. With the aid of diagrams, charts and slides, he gave a very fine program. Many questions were asked by the members at the close of his talk.

Refreshments were served and meeting adjourned at 10:00 P.M.

Edna Rohrabaugh
Secretary

Detroit Branch

The Detroit Branch has announced the dates for their annual Technical Session and Banquet, both to be held at the Sheraton Cadillac Hotel.

The technical session, to be held on Friday, November 30, 1956, at 8:00 P.M., will have as its topic, "Performance of Plated Coatings." The speakers are to be named at a later date.

The date for the banquet is Saturday, December 1, 1956. Tickets may be obtained from *John Drinkwater*, public relations chairman, or *Wright Wilson*, party chairman.

Philadelphia Branch

A dinner and meeting of the Philadelphia Branch, attended by over 80

members and guests, was held on Monday, September 24, 1956 at the Engineers Club.

Dr. Heiman, president of the A.E.S., gave a report at the meeting on the progress being made by the Society. *Bill Truesdale*, the branch president, then asked for the reports of various committees.

Guest speaker *Cleve Nixon*, of General Motors, gave a very interesting paper on anodizing of aluminum for trim on automobiles. It was well received and created a great deal of interest, as attested to by the many questions asked by the members.

Detroit Branch

The Detroit Branch has announced the dates for its annual Technical Session and Banquet, both to be held at the Sheraton Cadillac Hotel.

The technical session will be held on Friday, November 30, 1956, at 8:00 P.M. The speakers will be *A. Mendizza* of the Bell Telephone Laboratories who will present a statistical report on the salt spray test; and *Walter Pinner* of Houdaille Industries, who will report on latest developments in A.E.S. Project No. 15, dealing with the development of a new corrosion test.

The date for the banquet is Saturday, December 1, 1956. Tickets may be obtained from *John Drinkwater*, public relations chairman, or *Wright Wilson*, party chairman.

Syracuse Branch

The Syracuse Branch announces that the third Empire State regional meeting will be held on April 27, 1957, at the Grand Ballroom, Onondaga Hotel, Syracuse, N. Y.

Newark Branch

The annual meeting of the Newark Branch will be held on Friday, December 14, 1956, at the Robert Treat Hotel. *W. K. Murray*, of Enthone, Inc., will speak on "Overcoming Problems in Electroplating." The topic discussed by *E. L. Combs* of Diamond Alkali Co. will be, "Decorative and Hard Chromium Plating."

The Christmas Party will be held the following evening, Saturday, December 15, 1956, also at the Robert Treat Hotel, at 7:00 P.M.

Los Angeles Branch

With a record-breaking total of 24 local and out-of-town guests and 95 members in attendance, standing room was at a premium on the evening of October 10 when Los Angeles Branch met at the Roger Young Cafe in Los Angeles to hear a talk on "The Plating of Precious Metals" by *Barnet D. Ostrow*, technical director of Lea-Ronal, Inc., of Jamaica, N. Y.

Mr. Ostrow illustrated some points in his talk with slides which elaborated on his general commentary. While the talk covered both silver and gold plating, Mr. Ostrow devoted the major portion of his one hour talk to silver and its industrial applications in the decorative field of plating.

Branch chairman *Truman Stoner* presided over the business session which began at 7:30 p.m., at which seven new members were accepted. The membership approved the plans for three special meetings which are to be held before the close of the fiscal year in April. One evening before the end of the year will be called Old-Timers' Night. An effort will be made to assure the presence of all charter members who founded the branch in 1931, whether they are still active in plating or not. Some of the charter members who are still members of the branch are *Don Bedwell, Marcus Rynkofs, Earl Coffin, Frank Merigold* (retired) *Clarence Thornton* and *Ray Vasquez*. A night will also be set aside, probably in January, to honor the branch's sustaining members.

A Ladies' Night has been definitely scheduled for the night of Friday, De-

cember 14, for which purpose the regular December Wednesday night business and technical meeting has been cancelled. The object, as explained by President Stoner, is to get the ladies acquainted with one another since many of them will be active in the arrangements for the 1960 national convention in Los Angeles. An entertainment program and a small orchestra for dancing is planned.

The record-shattering total of 24 guests included the following, all of whom were individually introduced by the chairman:

Walter Robert, Trophycraft Co.; *Larry Brewer*, Leon, Inc.; *Robert Swisher* and *Al Polucha*, Albab Co.; *William Stoddard*, Wildberg Co.; *James Ferguson* and *C. Slocum*, Grayson Controls, Inc.; *Louis S. Barclay*, Kansas City Branch member, now with North American Aviation, Inc., El Segundo, Calif.; *Roy Stevens*, Electronic Insulator Co.; *C. Bockman*, Anadite, Inc.; *Alan Werber*, Sundmark Supply Co.; *Paul Barky*, and *Herman Krouse;* Layne Plating Co.; *John Eisenberger*, Convair, Inc., Pomona, Calif.; *Richard Booth*, Wyandotte Chemicals Co.; *King Rakley* and *Arnie Howe*, Michigan Chrome Co.; *Robert Golden* and *C. Porter*, Golden Plating Co.; *C. T. Henry*, Kelite, Inc.; *Mel Toleman*, Artcraft Plating Co., *Norman Davis* and *Robert Hall.*

ELECTROCHEMICAL SOCIETY

Dr. R. M. Burns, senior scientific advisor to Stanford University Research Institute, Palo Alto, Cal., has been awarded the Acheson Medal of *The Electrochemical Society* for 1956. The medal and a prize of $1,000 was presented to Dr. Burns on October 2 by *Hans Thurnauer*, president of the Society, during its national meeting at Cleveland, Ohio.

The Acheson Medal, awarded every two years for notable contributions to the advancement of the objectives, purposes and activities of the Society, was given this year in recognition of Dr. Burns' outstanding work on the corrosion of metals and his long-time participation and leadership in the affairs of the Society.

NATIONAL ASS'N. OF METAL FINISHERS

P. Peter Kovatis, national executive secretary of the NAMF, kicked off the St. Louis local fall program with a talk on September 28.

Addressing two dozen shop owners at the Hotel York at an evening meeting, Kovatis said that in the very near future platers will be able to obtain enough nickel to meet their demands but "not all the nickel they want." He pointed out that hearings and meetings are still being held by NAMF and congressional committees to determine reasons and causes of the nickel shortage in some areas of the metal finishing industry.

The former executive secretary of the *American Electroplaters' Society* praised NAMF members for their dynamic action in quest of a solution to the present nickel crisis which culminated in a congressional hearing in Washington this past summer; but he called for more concerted action.

"The small business man in the plating industry will get even smaller," warned Kovatis, "unless there is more concerted action by more members of industry to gain the recognition they are deserving as an important and vital segment of U. S.'s industrial economy."

Left to right: Henry L. Gros, vice-president; Edward J. Musick, president; NAMF executive secretary Peter Kovatis; NAMF director Henry J. Siegel; and Harvey W. Lubker, secretary-treasurer. (All are active members of the AES, notably "Ed" Musick who has gone through most all AES chairs including those of national president and national honorary member.)

He asked for closer inter-organizational and intra-industrial cooperation in issues which affect the broad plating spectrum. Issues usually affect every one in the field not just a part of it, he said.

Sponsored by the St. Louis Platers' Association, NAMF, the first fall meeting was arranged by national NAMF director *Henry J. Siegel*, Siegel-Robert Plating Co. and local president, *Edward J. Musick*, Musick Plating, Inc.

OBITUARIES

WILLIAM A. EHRENCRONA

William A. Ehrencrona, member of the Bridgeport Branch of A.E.S. died on August 24, 1956 at the age of sixty in the Bridgeport Hospital, where he had been admitted a few days previously for surgical treatment. He was a familiar and well known figure at all A.E.S. conventions.

Bill's career in electroplating started at an early age, after graduating from public school, was interrupted by World War I. After graduating from a naval training school as Gunner's Mate 3rd. Class, he served on the Destroyer U.S.S. Dupont. After his discharge from the Navy, Bill returned to electroplating and worked for many prominent companies in Bridgeport. To further his advancement, he studied chemistry evenings at Bridgeport Central High School, and later took additional courses at Yale University.

In 1924 Bill took a position as foreman plater with the Casco Products

Corp. Starting with a small old-fashioned plating room, he built his department up and modernized it with full automatic machinery. Today this plating room is one of the best in New England.

For several years, he had been Casco's Finishing Superintendent, having supervision over tumbling, polishing and buffing, still and automatic plating, and lacquering departments.

Active in the affairs of the Bridgeport Branch immediately upon becoming a member, Bill became secretary in 1936, and president in 1939. At the time of his death, he had been the senior member of the board of managers for many years. In 1953 Bridgeport Branch honored him by making him an Honorary Member. In the Bridgeport Branch, Bill was known as "Mr. Old Timer," for he was the perennial chairman of the "Annual Old Timers' Nite."

Bill's accomplishments were not confined only to electroplating and metal finishing. As a native Bridgeporter he gave of his time and services to many other activities. He was past president of the Trumbull Volunteer Fire Department, and a former chairman of the Trumbull Board of Assessors. Organizational Affiliations included St. John's Lodge 3 AF & AM; Ancient Accepted Scottish Rite; Jerusalem Chapter 13, R.A.M.; Pyramid Temple; Trumbull Square and Compass Club; Engihet Lodge 164; American Legion Post No. 141; and Trumbull Congregational Church and its Men's Club.


William A. Ehrencrona

Mr. Ehrencrona is survived by his wife, Edith Kalm Ehrencrona, a daughter, Mrs. Doris Kruzshak; a sister, Mrs. Anna McCarten; and two grandchildren. All of Bill's family and friends can pay him no higher tribute than to say that he will most certainly be missed.

NATHAN RANSOHOFF

Nathan Ransohoff, founder and chairman of the board of *Ransohoff, Inc.*, died September 24 at Cincinnati, Ohio. He had been active in business, civic and philanthropic affairs until a few weeks before his death.

Mr. Ransohoff had been characterized as "an outstanding mechanical engineer" and "father of many modern metal surface treatment methods." He was a 1910 graduate of the Massachusetts Institute of Technology and a member of the American Society of Mechanical Engineers and the Engineering Society of Cincinnati.

He founded the firm in 1916 and guided its development into one of the nation's leading manufacturers of metal cleaning and finishing machinery. In 1953, the firm was moved to Hamilton, Ohio.

Nathan Ransohoff

Mr. Ransohoff was widely known in the metalworking industry. He was a familiar figure at conventions and technical society meetings and a frequent contributor to trade and technical journals. In addition to his business career, Mr. Ransohoff was a prominent Cincinnati civic leader. He was a board member or trustee in a number of civic, educational and church organizations.

CECIL E. BRIGHAM

Cecil E. Brigham, of Great Neck, N. Y., passed away suddenly on September 5th. He was recognized as an authority on selenium rectification for the electroplating field. For many years he was also recognized for his work in the radio-electronic field. His works on selenium life characteristics have been published by the A.I.E.E.

Mr. Brigham was born in Worcester, Mass., in 1897. He served in the United States Navy in World War 1, was a graduate of George Washington University, Columbia University and the Colby Square Conservatory of Music.

For twenty-one years, Mr. Brigham occupied a high position in the International Telephone and Telegraph Co., serving overseas in England and on the Continent. He joined the Wesley Block Corp. in 1942 as a key executive. In 1945 he was elected to the office of executive vice-president of the Richardson-Allen Corp., a division of the Wesley Block Co., Inc., and contributed to its subsequent success.

Mr. Brigham is survived by his widow and a brother, Everett.

News from California

By Fred A. Herr

Bowman Chemicals, Inc., which has operated for the past ten years at 4606 Long Beach Blvd., Los Angeles, by *John* and *Laurence D. Bowman*, has been purchased by the major stockholders of Metal Improvement Co., also of Los Angeles, and will hereafter be operated as one of four divisions of that firm.

Metal Improvement Co. is controlled by *Fred Landecker*, *Henry Fuchs* and *Paul Schrage*. As general manager of their new division they have named *James C. Borger*, who has served as production methods engineer at Lockheed Aircraft Company's main plant in Burbank, Calif., for the past ten years. He's the man, incidentally, who

invented the patented process by which Lockheed Constallation wings are formed by shot peening.

Metal Improvement Co.'s plant is located at 1721 East 47th St., just a short distance from the Bowman factory. Both firms have operated job shops and sold equipment to overlapping trade circles. The latter served the metal finishing field with specialized conversion coatings; and the former featured shot peening and flame hardening. A third division—The Chromatizing Co.—specializes in chrome diffusion.

It has been announced that each of the divisions will continue under the direction of an owner-manager in order that personal attention can be given to customer problems. John and Laurence Bowman will remain in a direct consulting capacity with the Bowman Chemicals division for the next three months, and on an on-call consulting basis for two more years thereafter. A wish to retire while they still have some active years left to enjoy life was the factor that induced John and Laurence to sell the firm which they had built up with hard work over a period of ten years. Much of their leisure time hereafter will no doubt be spent in their favorite sport —hunting—from headquarters in a hunting lodge they maintain in the mountains near Los Angeles.

Ernest J. Hinterleitner, Los Angeles research chemist and consultant to the metal finishing industry, returned to Los Angeles on September 28 from a five weeks trip to Germany. He left Los Angeles on August 24 by air to visit his father, Hans Hinterleitner, in Bath Schwabach, Bavaria. He arrived on August 27, the day before his father's 83rd birthday, and took part in a family reunion and birthday celebration.

Mr. Hinterlietner, who went to Germany armed with letters of introduction to German plating leaders from METAL FINISHING's publisher, *Palmer H. Langdon*, and general-manager, *Thomas A. Trumbour*, made inspection trips to plating plants in various parts of West Germany, chiefly in the Rhine Valley and Ruhr districts. He inspected shops and installations in Munich, Dortmund, Nurenburg, Regensburg, Frankfort, Essen, Gelsenkirchen and a number of other industrial cities in Bavaria, Wurtemberg and Westphalia in the western section of Germany.

Among the matters of interest that came to his attention, he mentioned automatic barrel machines operating on a large scale; plating of sewing and gramophone needles, precious metal deposition on wire and strip on an automatic basis, high vacuum metallizing and hard and porous chromium installations.

Mr. Hinterleitner plans to incorporate his findings on plating methods in modern Germany in an article for METAL FINISHING.

Barnet D. Ostrow, technical director of Lea-Ronal, Inc., of Jamaica, N. Y., flew to California for a business and technical advisory trip during the early part of October. He conferred with distributors of the Lea-Ronal line in Los Angeles and San Francisco and also attended A.E.S. sessions in both cities. His conferences in Los Angeles were with *Jack Bealle* and *Tom Turner* of Crown Chemical & Engineering Co., *Jack Raskin* of L. H. Butcher Co., and *Roger Sundmark* of Sundmark Supply Co.; and in San Francisco with *Richard Coen* of L. H. B. and *J. R. Pattenger* of Crown Chemical.

Mr. Ostrow attended the October 10 meeting of Los Angeles A.E.S. Branch, where he delivered a paper on precious metal plating, and the following night met with members of San Francisco Branch.

Truman Stoner, president of Los Angeles Branch, A.E.S., has announced that, as a result of action taken at a recent special meeting of the general arrangements committee headed by *Harvey Hunt*, the branch's 1957 annual educational session will be held at the Ambassador Hotel, Los Angeles, on Saturday, March 23. The program now in process of arrangement will consist of a technical session from 9 a.m. to 12:30 p.m., at which three papers of pertinent interest to platers will be presented; a noon-day luncheon from 1 to 3 p.m. in the famous Cocoanut Grove of the Ambassador, at which the feature will be the annual Story Telling Contest; and a dinner dance from 8 p.m. to midnight. Hunt's assistant committeemen include Stoner, *Emmett Babcock, Larry Henderson, Fred A. Herr, Marty Bassoon, Glen Beckwith, Larry O'Neill, Hal Wannamaker* and *Phillip Simon*.

Space reservations are already being made for display booths at the Tenth Western Metal Congress and Metal Exposition which will be held March 25 to 29, 1957, at Pan Pacific Auditorium, Los Angeles. A meeting of the space

assignment committee was held in Los Angeles on September 14. The conference and show, which is held biennially in Los Angeles, is expected to attract approximately 400 western and national exhibitors in the fields of metal forming, manufacture and finishing.

Charles M. Schillmoller has been added to the staff of the western technical field section of the International Nickel Co.'s development and research division. Prior to joining Inco in 1952, Mr. Schillmoller was a corrosion engineer with the Richfield Oil Co. of Los Angeles.

Houghton Laboratories, Inc., of Olean, N. Y., have named *Lloyd A. Dixon, Jr.*, as west coast sales manager, with headquarters at the firm's western plant, 12320 Lucille St., Culver City, Calif. He recently completed several weeks of training at the firm's home office in Olean. Prior to joining the organization, Mr. Dixon served as sales engineer and west coast manager of Kirby Fiberglass Co.

H. S. Spaulding has been named as a staff metallurgist for Kaiser Aluminum & Chemical Corp.'s fabrication division, and will be headquartered at the main office in Oakland, Calif. He was succeeded as technical superintendent at the company's rod, bar, and wire conductor plant in Newark, Ohio, by *J. A. Ketchum*.

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1—2500/1250 Ampere, 9/18 Volt, Electric Products, Synch., Exc.-in-head. 25° C.
1—2000/1000 Ampere, 6/12 volt, Hanson-Van Winkle-Munning.
1—2000/1000 Ampere, 9/18 Volt, Electric Products.
1—1500/750 Ampere, 12/24 volt, Chandeysson, Synch., Exc.-in-head.
1—1000/500 Ampere, 6/12 Volt, Electric Products.

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1—750 Ampere, 60 Volt, Hanson-Van Winkle-Munning, Synch., Exc.-in-head.
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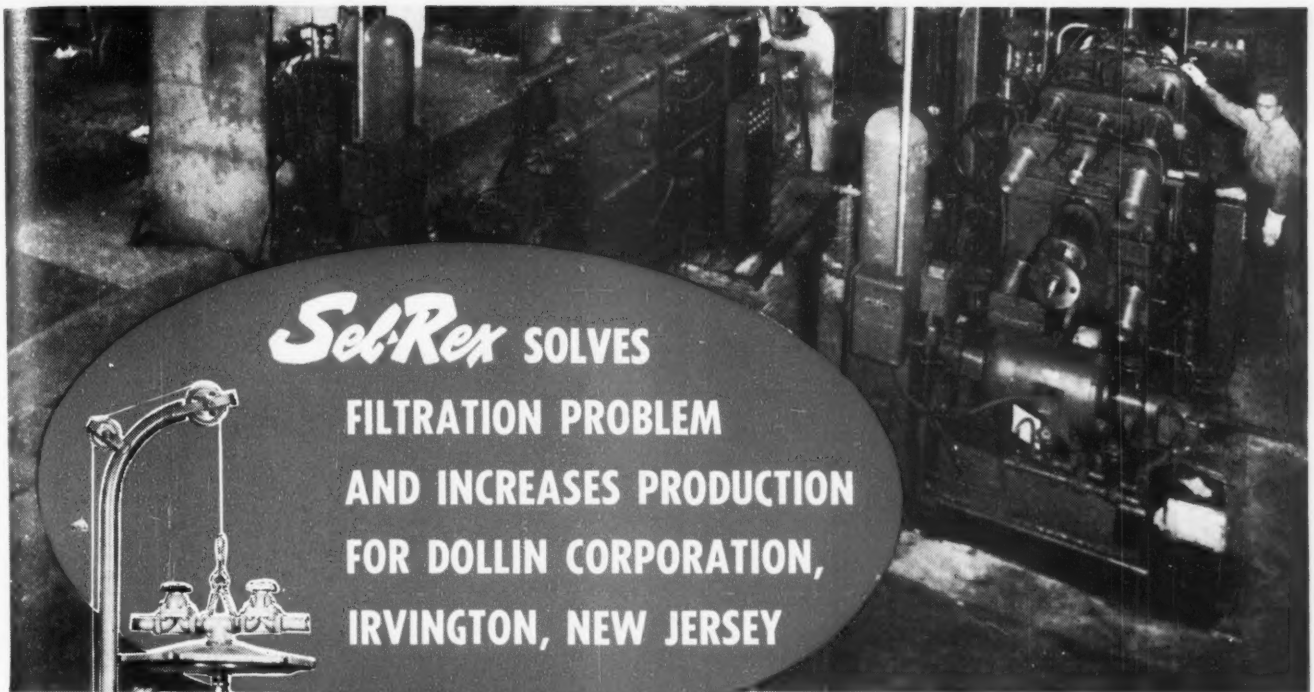

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